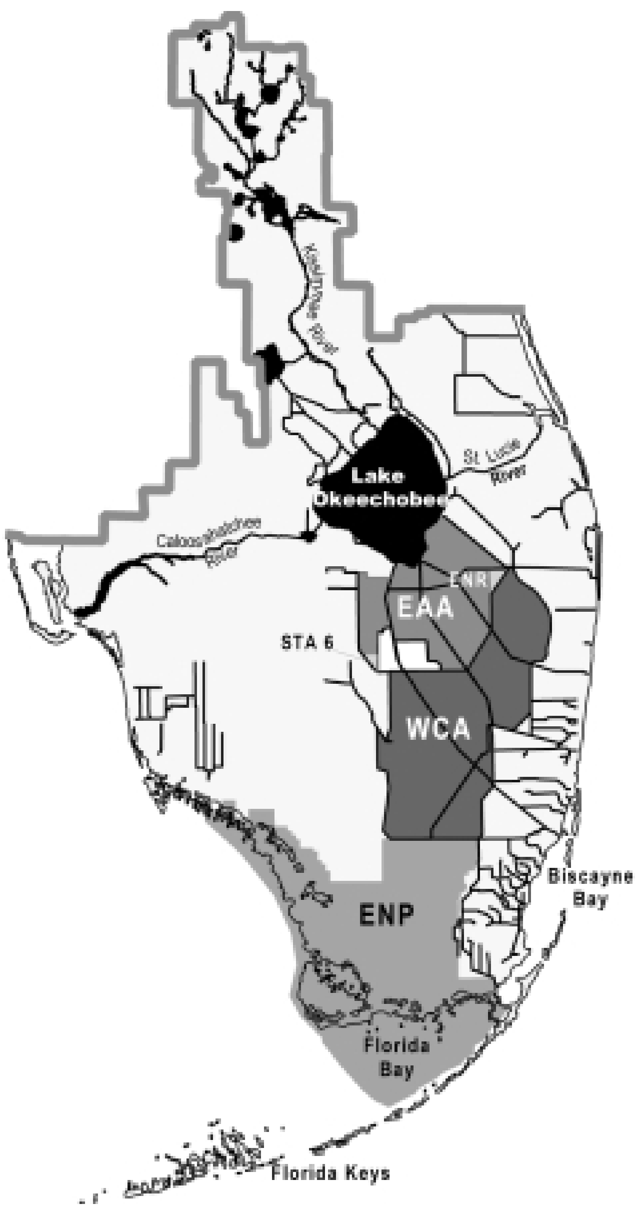
Water Quality Conditions Quarterly Report

JULY 2000

Environmental Monitoring and Assessment Division
South Florida Water Management District



This issue analyzes water quality and hydrologic data collected from January through March 2000. The map at the left highlights the major areas within the South Florida Water Management District covered in this report. For a detailed map and a summary of findings for each area, click on the appropriate links within each section.

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RAINFALL

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Monthly rainfall for January, February and March 2000 in various rainfall basins and stormwater treatment areas is presented in **Table 1**. The monthly rainfall totals are weighted averages of available data from rainfall gages reported in the South Florida Water Management District daily rainfall report compiled by the Water Resource Operations Division and from other agencies collecting rainfall data in South Florida.

Historically, the occurrence of rainfall in South Florida during the dry months (November through April) has been generally associated with occasional disturbances such as cold fronts. During the wet months (June through September) rainfall is attributed to frequent thunderstorms. May and October have been considered transitional months and can be either wet or dry.

La Niña continued influencing rainfall throughout the first quarter of 2000. District-wide rainfall for January was 1.01 inches, or 45 percent of the January historical average. This was the driest January since 1990. February was the fourth-driest in the last 50 years with an average of 0.63 inches of rain, or 29 percent of the historical average. March had increased rainfall with a District-wide average of 2.11 inches, however this amount was only 67 percent of the March historical average. The effects of the below-average rainfall can be observed in low inflows and total phosphorus loads entering Lake Okeechobee (**Figure 2**) and low phosphorus loads calculated for Everglades Agricultural Area (EAA) (**Figure 7**).

Table 1. Monthly Weighted Rainfall Averages (inches)

Rainfall Basin	Apr-99	May-99	Jun-99	Jul-99	Aug-99	Sep-99	Oct-99	Nov-99	Dec-99	Jan-00	Feb-00	Mar-00	Total
Upper Kissimmee	2.9	1.0	0.8	2.5	4.3	10.0	2.5	7.7	6.4	1.2	0.2	0.8	40.3
Lower Kissimmee	2.1	0.4	0.5	2.4	3.6	11.6	3.9	8.4	7.0	1.2	0.2	1.5	42.8
Lake Okeechobee	2.6	0.3	0.6	2.4	3.7	12.5	5.1	7.4	7.4	1.1	0.6	1.8	45.5
East EAA	2.3	1.0	0.5	1.1	4.4	11.9	5.5	5.1	9.2	1.0	0.8	2.3	45.1
West EAA	2.2	0.7	0.6	1.0	5.8	15.0	6.9	8.9	13.1	0.9	0.9	1.6	57.7
WCAs 1&2	3.3	2.3	0.5	1.3	2.9	17.1	3.2	7.5	8.6	1.2	0.4	5.7	54.0
WCA 3	2.4	1.1	0.3	1.6	3.7	13.3	4.5	8.1	9.5	0.7	1.1	2.4	48.7
ENP	0.0	0.1	0.0	1.2	4.8	12.3	*12.8*	***12.1***	***8.4***	0.4	0.5	1.0	***53.6***
C111 Basin	0.0	0.0	0.0	1.10	5.9	10.1	0.0	3.9	2.4	0.6	0.9	1.6	26.5
STA-1W	2.2	0.6	0.7	1.2	2.7	12.1	2.5	5.7	6.1	0.7	0.8	3.7	39.1
STA6	0.0	0.2	0.0	0.8	11.0	14.9	4.8	9.5	3.4	0.3	1.0	2.3	48.2

Italisized and bolded values are based on estimate average of rainfall at stations CHEKIKA, EVER and S332R

LAKE OKEECHOBEE DRAINAGE BASIN

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Phosphorus Loading and Rainfall Trends

Historic and monthly data for rainfall, flows and phosphorus loads to Lake Okeechobee are presented for 1999 (**Figure 1**) and the first quarter of 2000 (**Figure 2**). In both figures, monthly values for each of these parameters are depicted as bars. Solid lines represent the monthly means based on the previous 20-years of data. A 20-year period was chosen because it provided the best water quality data set and covered both draught and wet conditions. The dashed and dotted lines in each figure depict the 95 percent confidence interval about this 20-year mean. The confidence interval shown in **Figures 1** and **2** depict the expected range of data for the 20-year period.

Monthly rainfall shown in each of the figures is presented as area-weighted averages from a network of meteorological stations in the Upper Kissimmee, Lower Kissimmee and Lake Okeechobee basins. Flows are compiled from directly measured data at 26 monitoring stations that discharge into the lake. Phosphorus loads to the lake were calculated by multiplying concentration data from those 26 monitoring stations and their respective flow data.

Higher phosphorus loads have typically occurred during wetter months (June through October), while lower loads occur during drier months of the year (**Figures 1** and **2**). In 1999, June through October exhibited higher rainfall than 20-year average for these months. As a result, both flows and phosphorus loads for these five months were greater than their 20-year means (**Figure 1**).

However, climatic disturbances (such as El Niño, tropical storms and hurricanes) can alter this seasonal distribution of phosphorus to the lake. During October 1999, 205 metric tons of phosphorus entered the lake as a result of Hurricane Irene as well as scheduled releases of water from Lake Kissimmee (**Figure 1**).

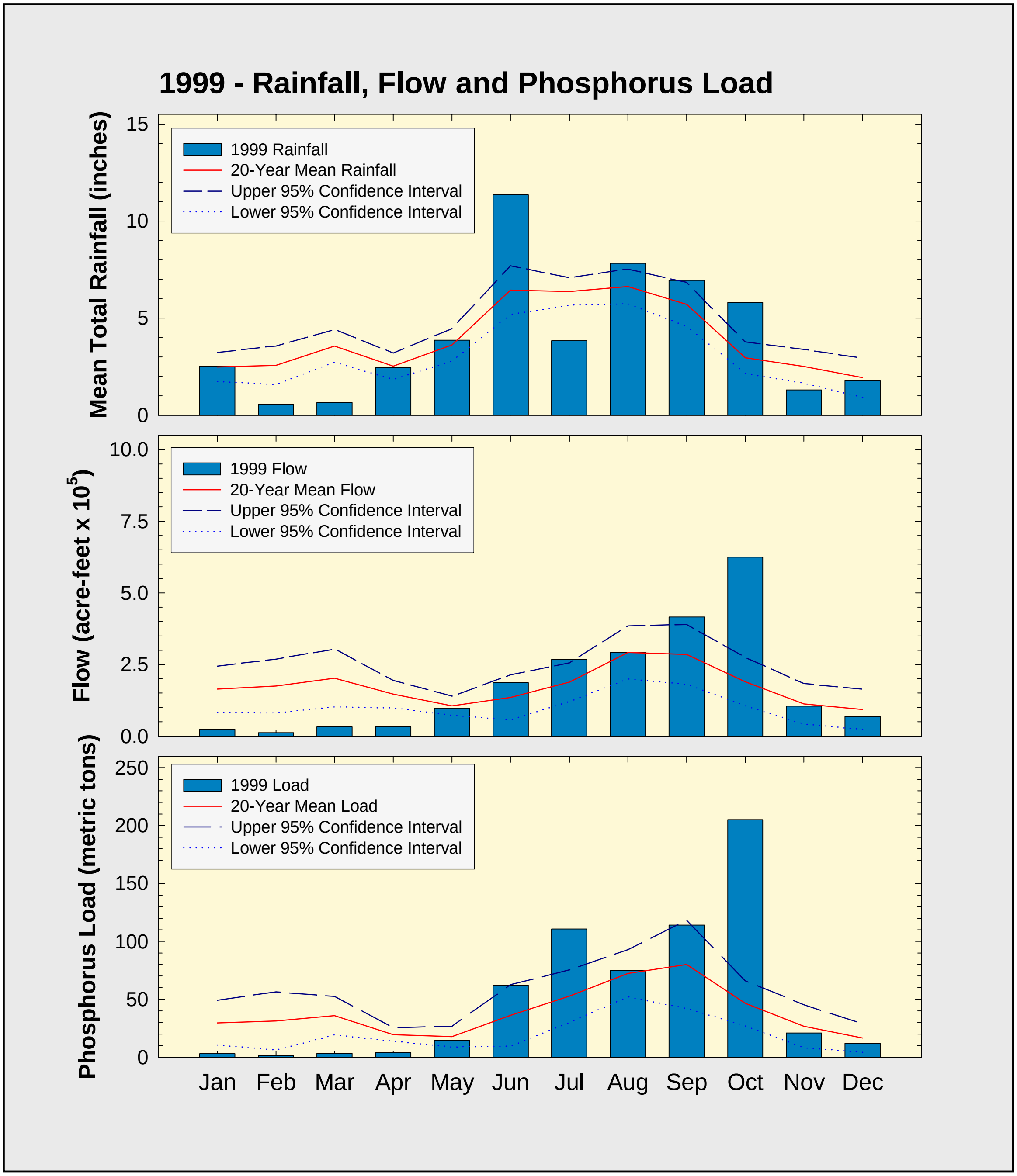

Figure 1. Monthly total phosphorus rainfall, flow and loads for Lake Okeechobee.

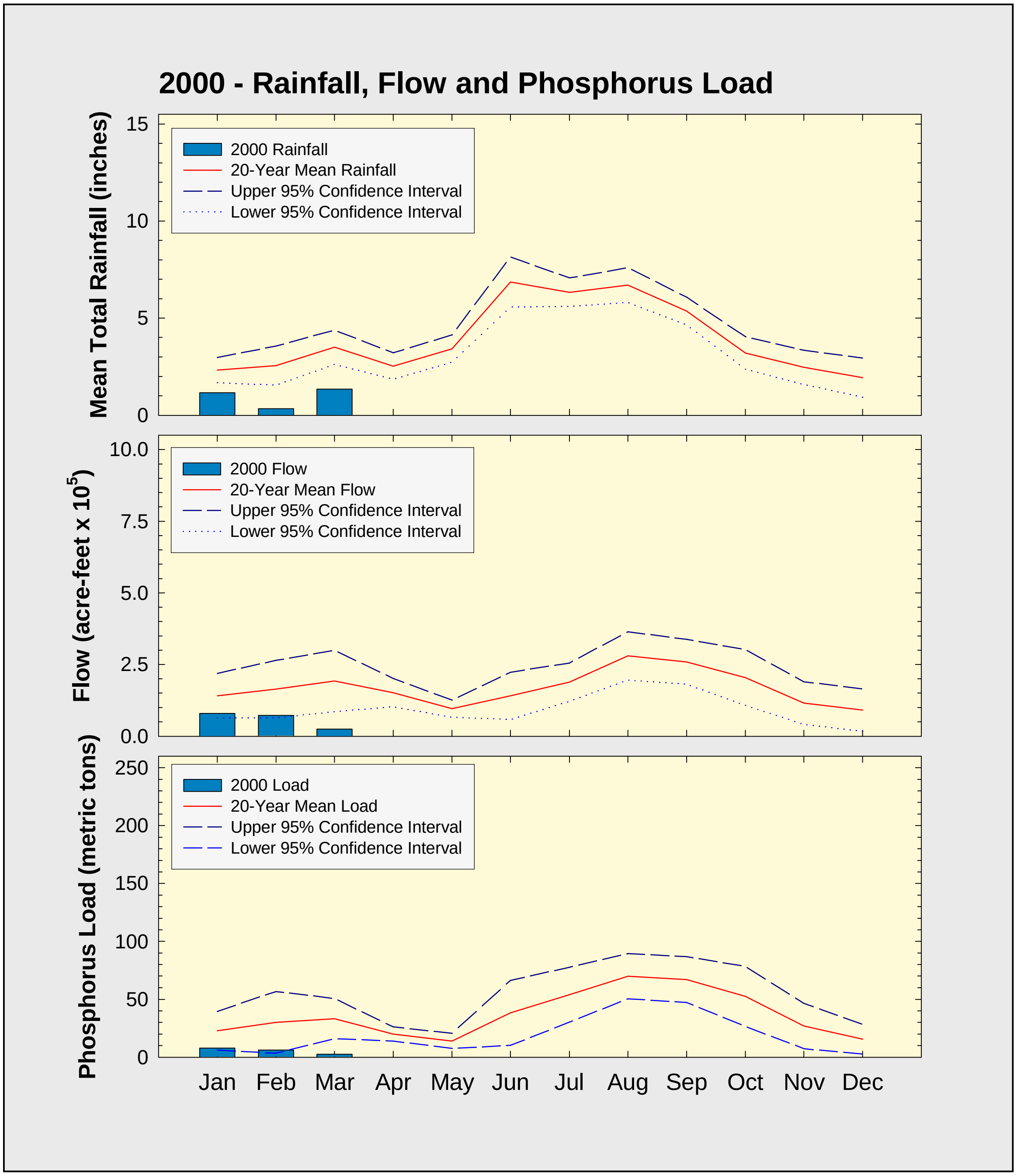

Figure 2. Monthly total phosphorus rainfall, flow and loads for Lake Okeechobee.

For much of the first quarter of 2000, dry conditions prevailed. Monthly rainfall amounts for January, February and March were 1.16, 0.34 and 1.34 inches, respectively (**Figure 2**). These values were approximately 2 inches less than the 20-year average and one inch less than recorded for the same period in 1999.

The low rainfall reported during the first quarter of 2000 also resulted in low phosphorus input to the lake. Phosphorus loads to Lake Okeechobee in January, February and March were 7.8, 6.2 and 2.5 metric tons, respectively (**Figure 2**).

Approximately 87 percent of the phosphorus load to the lake entered through the S65E structure, which also accounted for approximately 90 percent of the inflow volume. The phosphorus load in the first quarter of 2000 was approximately five times lower than the 20-year average for the same period (**Figure 2**).

Phosphorus Concentrations in the Tributaries/Basins

The phosphorus concentration target for each basin was established under the 1989 Interim Surface Water Improvement and Management (SWIM) Plan. This target was incorporated to ensure a reduction in phosphorus loads to Lake Okeechobee. Under this SWIM Plan, the phosphorus concentration in each basin must either be below 180 parts per billion (ppb) or at the 1989-discharge concentration, whichever is less.

Flow-weighted mean concentrations of total phosphorus from four of the 39 basins that drain into Lake Okeechobee were used to calculate the 12-month moving average concentrations shown in **Figure 3**. Kissimmee River, S154, Fisheating Creek and Taylor Creek/Nubbin Slough Basins are major contributors of phosphorus load into the lake. These 12-month moving average concentrations are compared to their respective targets (**Figure 3**).

Since May 1991, 12-month moving average phosphorus concentrations for the Kissimmee River Basin have consistently been below the target concentration of 180 ppb (**Figure 3**). However, 12-month moving average phosphorus concentrations for the S154 Basin and Taylor Creek Nubbin Slough have been consistently above the target level.

The 12-month moving average phosphorus concentrations for Fisheating Creek have periodically been below the target level. From October 1996 through September 1999, the 12-

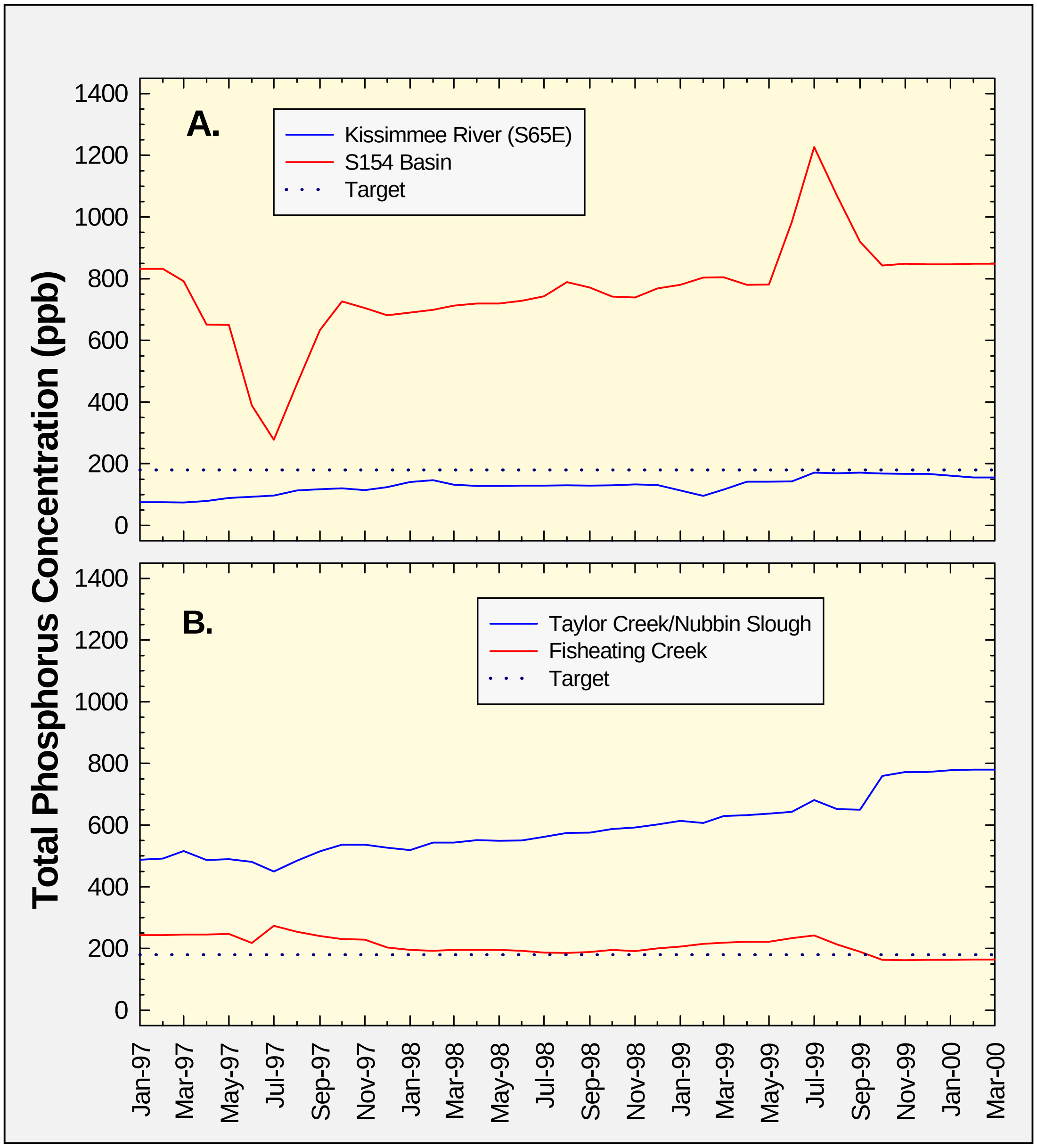

Figure 3. Twelve-month moving flow-weighted mean total phosphorus concentrations for: **a.** Kissimmee River and S154 Basins and **b.** Taylor Creek/ Nubbin Slough and Fisheating Creek. The four basins/tributaries drain into Lake Okeechobee.

month moving average phosphorus concentration in the creek has been consistently above the target concentration of 180 ppb (**Figure 3**). Throughout the first quarter of 2000, the 12-month moving average phosphorus concentration in Fisheating Creek remained below the target limit.

During the first quarter of 2000, the 12-month moving average phosphorus concentrations from the S-154 Basin were unchanged from the previous quarter. Nevertheless, the 12-month moving average phosphorus concentrations remained above the target level (**Figure 3**).

A slight increase the 12-month moving average phosphorus concentrations was observed for the Taylor Creek/ Nubbin Slough Basin for the first three months of 2000 (**Figure 3**). Over the last six months, concentrations in this basin increased by only 8ppb.

Total Phosphorus Concentrations

Lake Okeechobee has a long history of excessive phosphorus loading, and this has resulted in major changes in the ecosystem, including an increased frequency of algal blooms, dominance by blue-green algae, and the accumulation of over 30,000 metric tons of phosphorus in the lake sediments. From the early 1970s to the 1990s, total phosphorus concentrations in the lake's water column increased from below 50 ppb to over 100 ppb. This range may be the result of resuspension and settling of the phosphorus-rich lake sediments caused by wind and waves. The South Florida Water Management District and other agencies have initiated an aggressive program to further reduce external phosphorus loads to the lake and are conducting a feasibility study to determine the ecological, engineering and economic implications of removing all or part of the muddy, phosphorus-rich sediments.

In order to assess the seasonal and spatial variations in phosphorus concentrations in the lake resulting from inputs as well as internal cycling, distribution plots of open-water total phosphorus concentrations are presented in **Figures 4a** through **4c**.

Total phosphorus concentrations in Lake Okeechobee increased from January through March 2000. The highest concentrations observed for the three monitoring events were in the central portion of the lake. During January 2000, the arithmetic average of surface water phosphorus concentrations in Lake Okeechobee was 144 ppb. The contour plot of total phosphorus concentrations in the lake (**Figure 4a**) shows more than 95 percent of the lake's surface waters had phosphorus

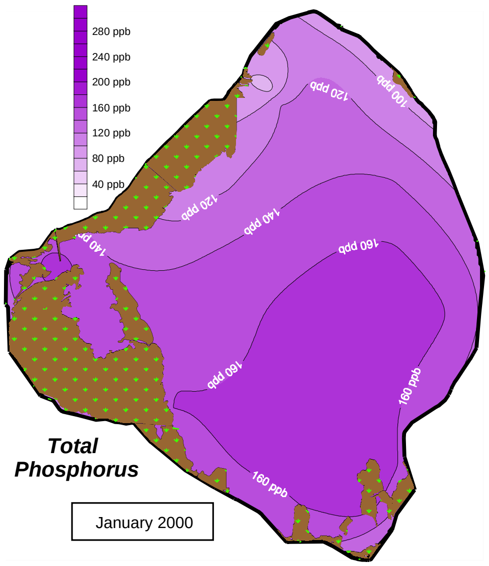

Figure 4a. Total phosphorus concentrations for open water monitoring sites in Lake Okeechobee, January 2000.

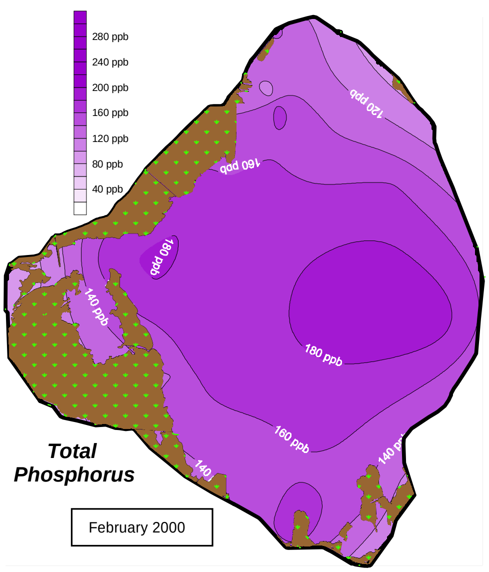

Figure 4b. Total phosphorus concentrations for open water monitoring sites in Lake Okeechobee, February 2000.

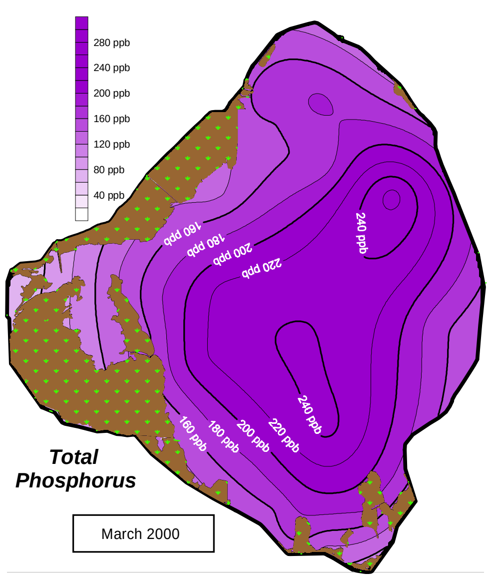

Figure 4c. Total phosphorus concentrations for open water monitoring sites in Lake Okeechobee, March 2000.

concentrations greater than 100 ppb. Approximately 27 percent of the lake's area had concentrations greater than 160 ppb. These concentrations were located in the south-central portion of the lake.

Contour plots for February and March show higher phosphorus concentrations across the lake (**Figures 4b** and **4c**) than in January. During both months, approximately 95 percent of Lake Okeechobee had phosphorus concentrations greater than 100 ppb. Total phosphorus concentrations in the surface water of the lake averaged 156 ppb in February 2000. Approximately 48 percent of the lake’s surface exhibited concentrations greater than 160 ppb. This area of higher phosphorus concentrations was located toward the central portion of Lake Okeechobee (**Figure 4b**).

The average total phosphorus concentration for Lake Okeechobee in March 2000 increased to 175 ppb. The area of highest phosphorus concentrations was located in the central portion of the lake and stretched from Fisheating Bay toward the eastern shore (**Figure 4c**). Approximately 65 percent of the lake had total phosphorus concentrations greater than 160 ppb.

The high phosphorus concentrations observed during first quarter of 2000 may have resulted from wind-driven resuspension of sediment mud layer. The thickness of this mud layer ranges from 10 to 80 centimeters (cm). The upper 10 to 15 cm of the sediments can be resuspended easily. Because the sediments in the lake are fine-grained and phosphorus-rich, any resuspension will result in elevated phosphorus levels. The central portion of Lake Okeechobee is the most susceptible to sediment resuspension.

Light Penetration

Secchi depth is a measure of how deep light penetrates the water column. The Secchi depth is measured by lowering a 30-cm diameter white disk through the water column until it is just visible. At the Secchi depth, solar light penetrating the water is reflected off the surface of the disk in a quantity just sufficient to come back through the water and reach the observer's eye. The depth to which light will penetrate is affected by the amount of suspended material and dissolved colored substances in the water column. When either of these two variables is high, light will not penetrate deeply into the water column (*i.e.*, Secchi depth decreases).

The transmission of light in lakes and other bodies of water is extremely important because solar radiation is the primary source of energy for photosynthetic organisms like algae. An increase in light penetration can cause increased photosynthetic activity, resulting in higher primary productivity, if nutrients are not limiting.

During the first quarter of 2000, Secchi depths decreased. The average Secchi depths measured for the first three months of 2000 were 0.29 meters in January, 0.23 meters in February and 0.17 meters in March. Contour plots showing the Secchi depths for these three months are provided in **Figures 5a** through **5c**.

Light penetration in Lake Okeechobee extended down to a maximum depth of 0.8 meters during the January 2000 monitoring event (**Figure 5a**). Over approximately 85 percent of the lake, light penetrated to less than 0.4 meters in depth.

As a result of turbulent mixing in the lake, approximately 95 percent of the lake had Secchi depths of less than 0.4 meters for both the February and March monitoring events. Overall, low Secchi depths occur in the same region of the lake where phosphorus concentrations increase.

Chlorophyll *a* Concentrations

Chloropyll *a* is a green pigment present in terrestrial and aquatic plants, including algae. This pigment functions to absorb visible light. The energy associated with the absorbed light is used to drive photosynthesis. Chlorophyll *a* concentrations are an indicator of the amount of living plant (or algal) material in a water body.

Naturally occurring algal populations present in Lake Okeechobee will form blooms under certain weather and water quality conditions.

Algal blooms are dense concentrations of algae over large areas of a water body. Blooms may be composed of undesirable species that are harmful to other aquatic life, may form nuisance mats on the water surface, and create taste and odor in the drinking water supply. If algal populations are large enough, they can also reduce oxygen levels in the water column during algal die-off resulting in invertebrate and fish kills.

Severe bloom conditions generally occur when chlorophyll *a* concentrations exceed 60 ppb. Concentrations between 40 and 60 ppb are indicative of moderate bloom conditions. The occurrence and effects of these bloom conditions on the lake depend on a variety of factors. Persistence of bloom conditions over large areas may indicate increased nutrient concentrations.

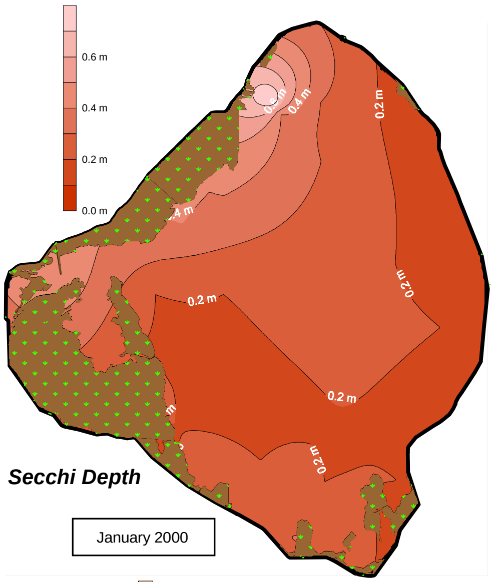

Figure 5a. Depth of light penetration (Secchi depth) measured in meters for Lake Okeechobee, January 2000

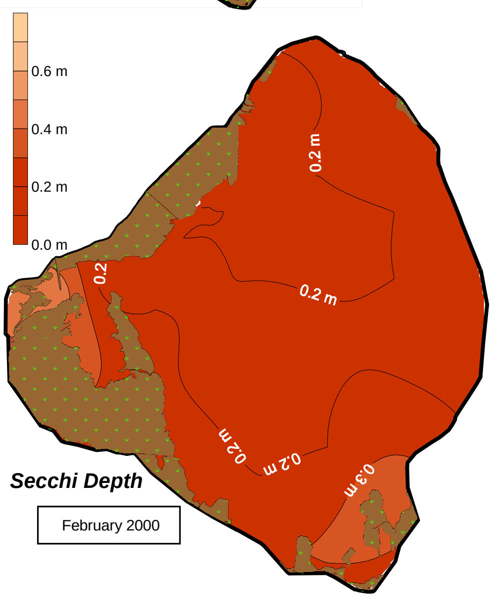

Figure 5b. Depth of light penetration (Secchi depth) measured in meters for Lake Okeechobee, February 2000

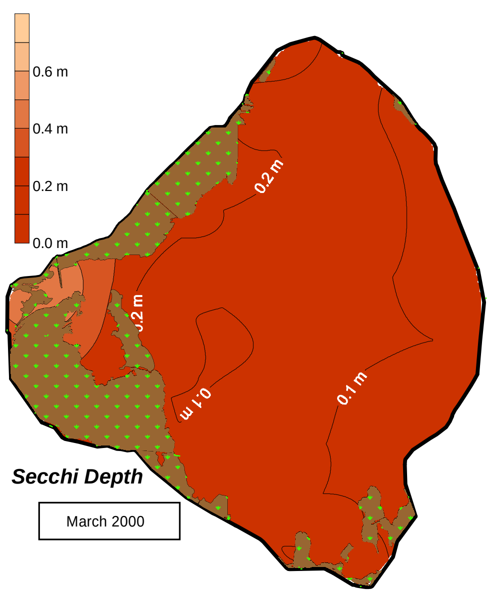

Figure 5c. Depth of light penetration (Secchi depth) measured in meters for Lake Okeechobee, March 2000

Lake-wide chlorophyll *a* distributions at 15 open water and 15 littoral water quality monitoring stations for January 2000 through March 2000 are presented in **Figures 6a** through **6c**. During these three months, mean chlorophyll *a* levels in Lake Okeechobee were 13.8 ppb in January, 15.9 ppb in February and 15.8 ppb in March. These levels are lower than those reported during the same period in 1999.

No bloom conditions were observed in the lake for January 2000 (**Figure 6a**). Approximately 85 percent of the lake had chlorophyll *a* concentrations below 20 ppb.

Moderate and severe bloom conditions existed in the lake during the February and March sampling events (**Figures 6b** and **6c**). Less than 1 percent of the surface water of the lake exhibited severe bloom conditions with approximately 7 percent exhibiting moderate bloom conditions during these two months. These blooms occurred in the western portion of the lake and within Fisheating Bay.

Although phosphorus concentrations reported for the lake during the first quarter of 2000 were relatively high, bloom conditions were observed in areas of low phosphorus concentrations. The growth of algal material during the first quarter of 2000 was probably limited by the amount of light that could penetrate the water column. Because of sediment resuspension, light penetration was reduced resulting in lower photosynthetic activity in the water column. Low chlorophyll *a* concentrations in the lake coincide with areas having high phosphorus concentrations and low Secchi depths.

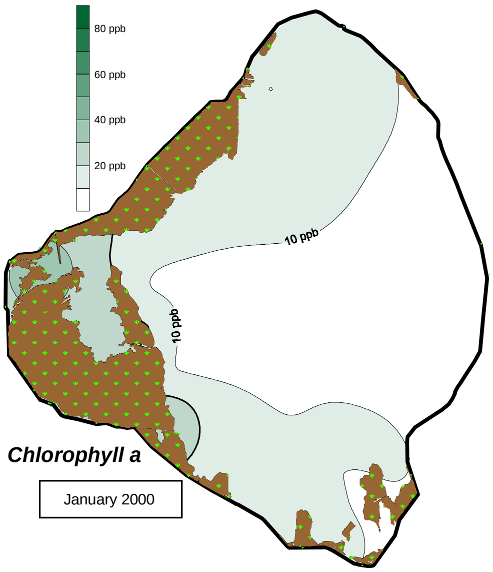

Figure 6a.
Chlorophyll *a* levels at open water monitoring sites in Lake Okeechobee, January 2000

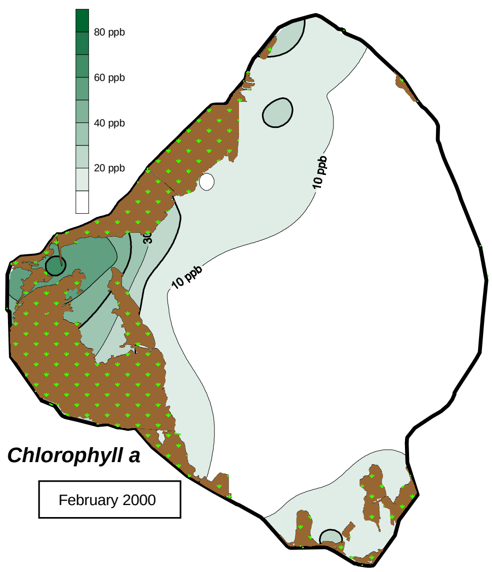

Figure 6b.
Chlorophyll *a* levels at open water monitoring sites in Lake Okeechobee, February 2000

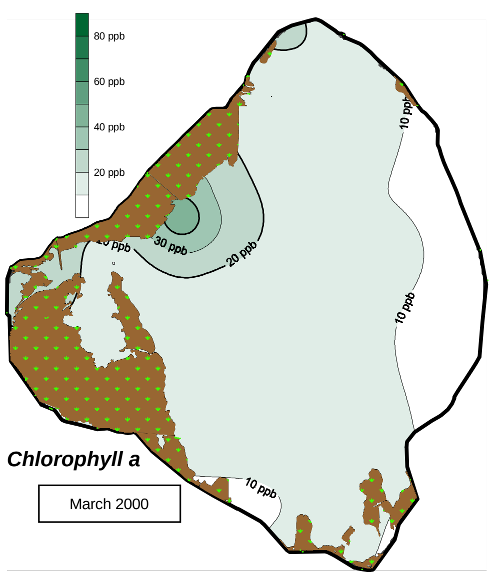

Figure 6c.
Chlorophyll *a* levels at open water monitoring sites in Lake Okeechobee, March 2000

EVERGLADES AGRICULTURAL AREA

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Phosphorus Loading Trends

The Everglades Best Management Practice (BMP) Program (Rule 40-E, 63, Florida Administrative Code) for the Everglades Agricultural Area (EAA) requires that the EAA basin achieve a 25 percent reduction in total phosphorus (TP) load discharge to the Everglades. This reduction is determined by comparing phosphorus discharges at the end of each water year (May 1 through April 30) with the pre-BMP base period of Oct. 1, 1978, through Sept. 30, 1988. This area has been in compliance since the first full year of BMP implementation (water year 1996).

After heavy rainfall and flows caused by Hurricane Irene in October 1999 resulted in the highest total phosphorus load (54 metric tons) from the EAA in 1999, low rainfall and flow during the first quarter of 2000 resulted in low phosphorus loads throughout the quarter (5 metric tons) (**Figure 7**). The effect of Hurricane Irene on total phosphorus load was less than that of Tropical Storm Mitch in November 1998 (73 metric tons). In addition, flow in

October 1999 (349 thousand acre-feet) was higher than flow in November 1998 (339 thousand acre-feet). Rainfalls for the two months are similar (9.6 inches in November 1998 and 9.2 inches in October 1999). One of the reasons for the lower load impact is that Hurricane Irene followed a wet September 1999 (9.6 inches of rainfall and 224 thousand acre-feet of flow), while Tropical Storm Mitch followed a dry October 1998 (1.6 inches of rainfall and 23 thousand acre-feet of flow).

Total phosphorus concentrations and flows are measured at South Florida Water Management District pump stations S5A, S6, S7 and S8 (see map). These four pump stations convey a majority of the water from the EAA to the water conservation areas (WCAs). Flows through these structures, as well as the calculated total phosphorus loads, are shown in **Figure 8**. Flow-weighted mean total phosphorus concentrations entering the WCAs at these stations are presented in **Figure 9**. During the first quarter of 2000, little or no flows were reported at these stations resulting in little or no loads.

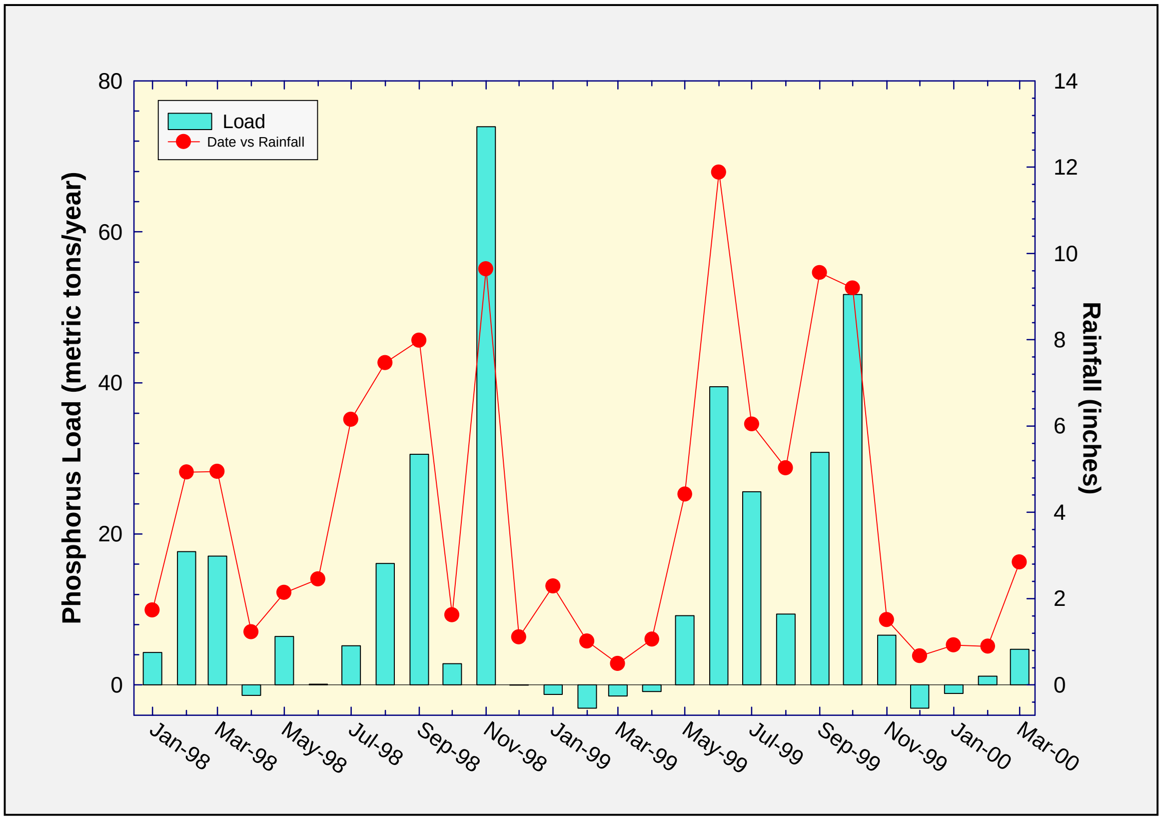

Figure 7. Monthly phosphorus loads attributed to the EAA Basin and monthly rainfall for the EAA.

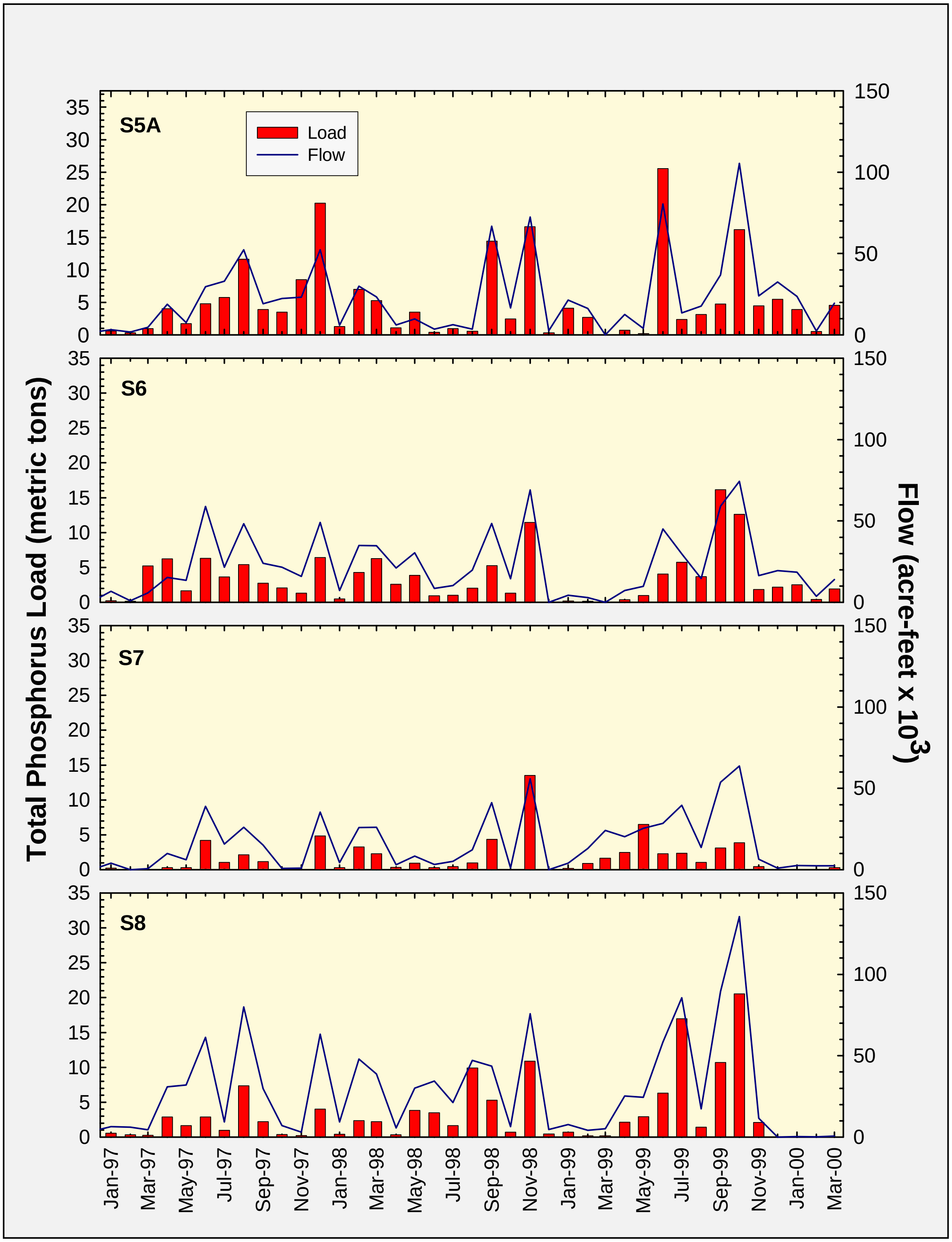

Figure 8. Monthly flows and calculated phosphorus loads at major EAA pump stations.

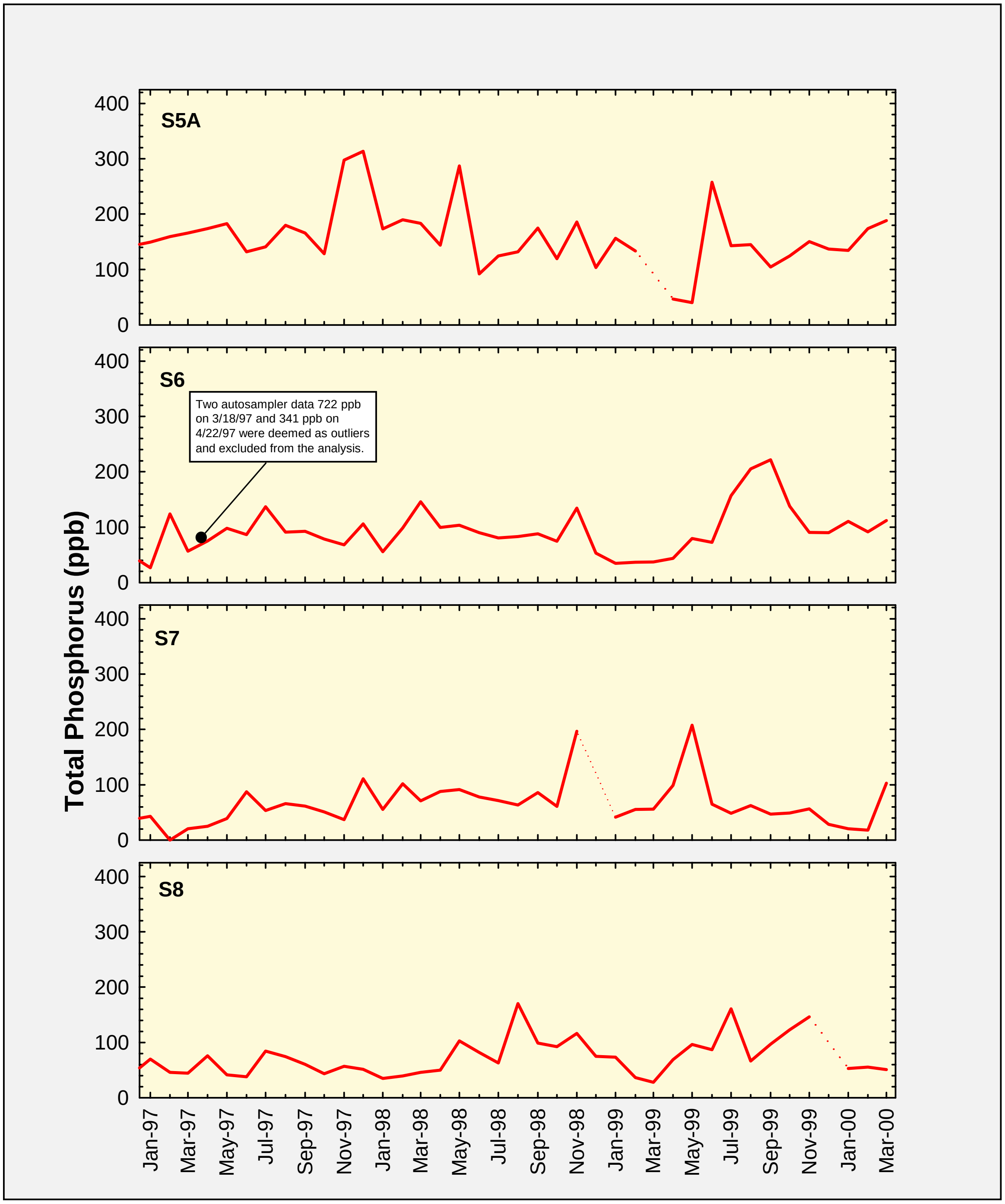

Figure 9. Monthly flow-weighted mean total phosphorus concentrations at major EAA pump stations (dotted lines indicate missing data).

A summary of monthly flows measured at each structure during the first quarter of 2000 is presented in **Table 2**. In addition, total phosphorus loads for each structure during the reporting period are summarized in **Table 3**. Flow-weighted mean total phosphorus concentrations determined at the four pump stations during the first quarter of 2000 are presented in **Table 4**.

Table 2. EAA Pump Station Flows (kac-ft)

	Jan-00	Feb-00	Mar-00
S5A	24	2	20
S6	19	4	14
S7	3	2	2
S8	0.2	0.2	1
Total	**45**	**9**	**37**

Table 3. EAA Pump Station Total Phosphorus Loads (metric tons/month)

	Jan-00	Feb-00	Mar-00
S5A	3.9	0.5	4.5
S6	2.5	0.4	1.9
S7	0.1	0.1	0.3
S8	0.02	0.01	0.04
Total	**6.5**	**1.0**	**6.8**

Table 4. EAA Pump Station Flow-Weighted Mean Total Phosphorus Concentrations (ppb)

	Jan-00	Feb-00	Mar-00
S5A	134	174	188
S6	110	92	112
S7	21	18	103
S8	53	56	51

STORMWATER TREATMENT AREA 1 WEST

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Stormwater Treatment Area-1West (STA-1W) encompasses the four treatment cells of the Everglades Nutrient Removal Project (ENR) plus the newly constructed treatment Cell 5 creating a total effective treatment area of 6,870 acres. The permit for the ENR expired at the end of April 1999. The STA-1W permit went into effect May 11, 1999. Cell 5 passed the startup phase of operation for both phosphorus and mercury during the week of Jan. 17, 2000.

In accordance with construction plans, the inflows to STA-1W were diverted July 12, 1999, from pump station G250 to inflow structure G302, a component of the new Inflow and Distribution Works for STAs-1W and 1E. As a result of the diversion, pump station S5A became the inflow monitoring station for STA-1W. The outflow site (G251) from the ENR permit remains the same for the STA-1W permit along with the G310 pump station when it is completed.

Differences Between ENR and STA-1W Permits

The requirement in the ENR permit to achieve a 75 percent reduction in total phosphorus over each 12-month period was not included in the STA-1W permit. In addition, the requirement to compare inflow versus outflow concentrations of total phosphorus using a 28-day residence lag time within the ENR also was not included in the STA-1W permit. As a result of these changes, the 12-month moving total phosphorus reduction values and the 75 percent reduction target were not continued past April 1999 (**Figure 10a**). However, the monthly percent load reduction will continue to be included in future reports.

This report presents only the monthly inflow and outflow total phosphorus loads (**Figure 10b**) and concentrations (**Figure 11**). A 12-month moving average for the new inflow monitoring station at S5A can not be calculated until the end of June 2000 when 12 months of data are available to calculate.

Phosphorus Loads and Concentrations

Total phosphorus loads in STA-1W were reduced by 87 percent in January, 40 percent in February, and 91 percent in March 2000 (**Figure 10a**). During the first quarter of 2000, 8.83 metric tons of total phosphorus went through S5A compared with 1.22 metric tons discharged from the outflow of STA-1W (G251) (**Figure 10b**).

The monthly average flow-weighted mean total phosphorus concentrations through S5A into STA-1W were 135, 185 and 185 ppb for January, February and March, respectively (**Figure 11**). The flow-weighted mean concentrations in the outflows (G251) were 32, 32, and 32 ppb for the same three months.

Mercury Concentrations

The STA-1W permit requires the South Florida Water Management District to collect unfiltered water samples from inflows and outflows quarterly for analysis of total mercury (THg) and methylmercury (MeHg). Sampling for mercury started Feb. 16, 2000. It should be noted that at the time these samples were collected, construction of the second outflow pump, G310, was not complete and all outflows went through G251. THg concentrations in the inflow and outflow were 0.94 and 0.27 ng/L, respectively. The MeHg concentrations in the inflow and outflow were 0.055 and 0.05 ng/L, respectively.

Concentrations of both THg and MeHg were within the typical range previously measured in this area when it was operated as the ENR Project (note, the inflow station has moved from ENR002 to S5A). THg concentrations in the inflow and outflow were both below the Class III Water Quality Standard of 12 ng/L.

moved from ENR002 to S5A). THg concentrations in the inflow and outflow were both below the Class III Water Quality Standard of 12 ng/L.

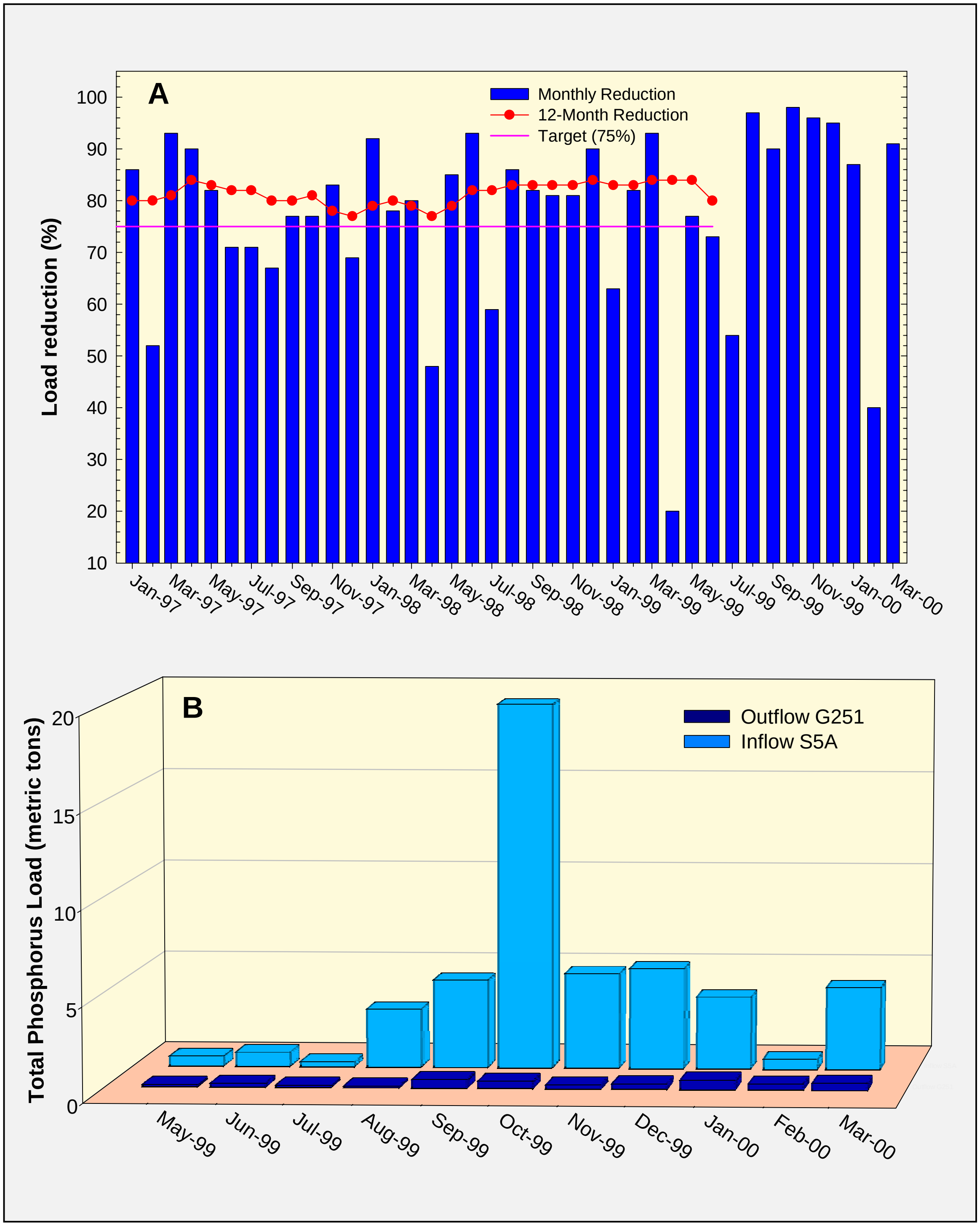

Figure 10. **a.** Monthly percent reduction of total phosphorus in STA-1W. **b.** Monthly total phosphorus loads at inflow and outflow sites of STA-1W.

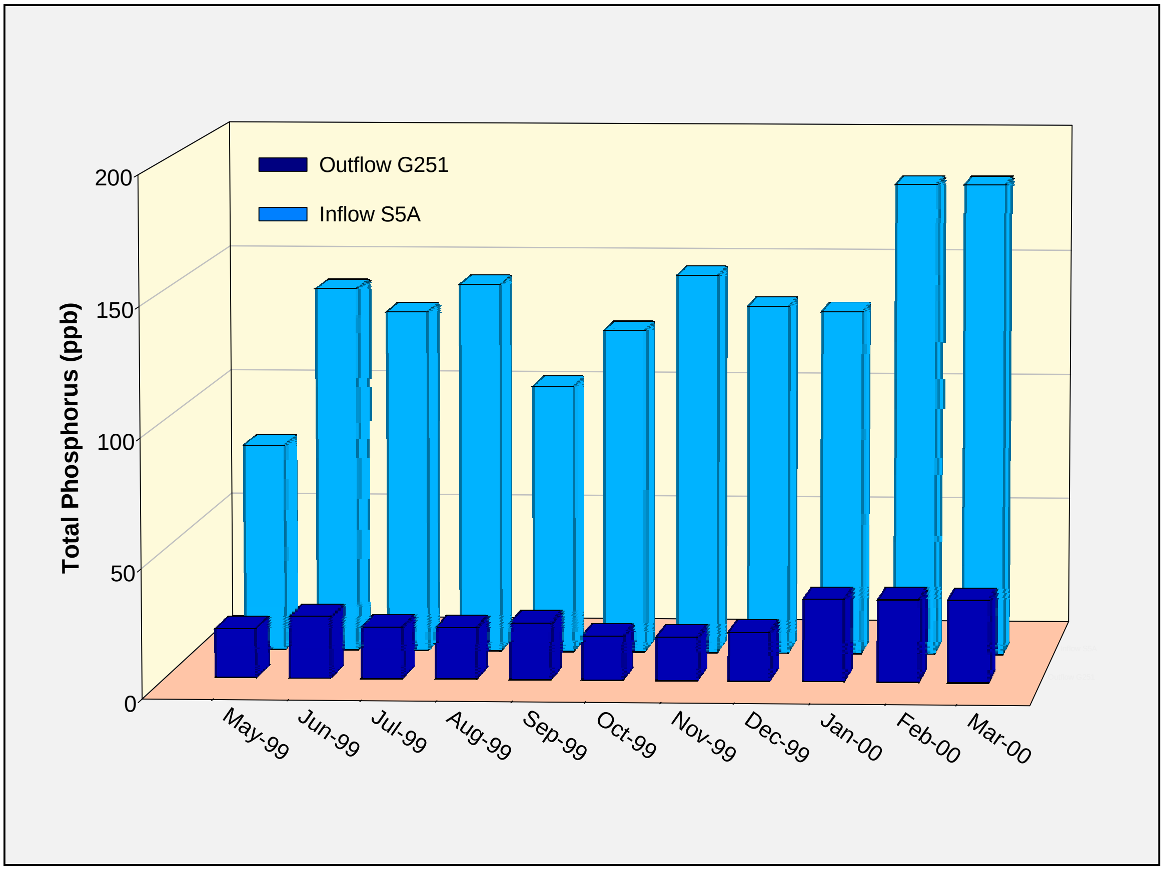

Figure 11. Monthly flow-weighted mean total phosphorus concentrations at inflow and outflow sites of STA-1W.

HOLEY LAND

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The Holey Land Management Area (Holey Land) is a 35,000-acre tract of land that is operated as a wildlife management area by the Florida Fish and Wildlife Conservation Commission (FFWCC). A Memorandum of Agreement between the Florida Department of Environmental Protection (FDEP), the Board of Trustees of the Internal Improvement Trust Fund, the FFWCC and the South Florida Water Management District established an environmental restoration plan for the Holey Land. As part of the restoration plan, water quality monitoring was implemented to meet the requirements of FDEP Permit No. 06-500809209.

Water quality monitoring is conducted at six surface water inflow and outflow structures as shown in the map (click link above to view map). Nutrient inputs to the Holey Land can occur through surface water inflows from the Miami Canal (G200) and seepage return pumps (G200SD and G201).

Hydrology

The restoration effort also includes an operational plan for maintaining surface water levels (schedule) within the Holey Land. During the wet season from May 15 through Oct. 31, the schedule rises linearly from approximately 10.5 feet National Geodetic Vertical Datum (NGVD) to 12 feet NGVD. During the dry season from Nov. 1 through May 14, the schedule declines

linearly from 12 feet NGVD to 10.5 feet NGVD. Prior to 1996, the schedule was maintained between 11.5 feet and 13.5 feet NGVD. During wet years when sufficient rainfall can maintain the stage in the Holey Land according to schedule, less surface water inflow from the Miami Canal is required. The restoration plan requires the outflow structures (G204, G205 and G206) to be closed. However, unregulated flows from the outflow structures occur through seepage.

Figure 12a demonstrates the relationship between rainfall and average stage level in the Holey Land, and inflows from the Miami Canal (G200) for the period from January 1997 through March 2000. Also shown in **Figure 12a** are monthly flows into the management area. The drier conditions observed in the first quarter of 2000 resulted in lower average stage levels in the Holey Land.

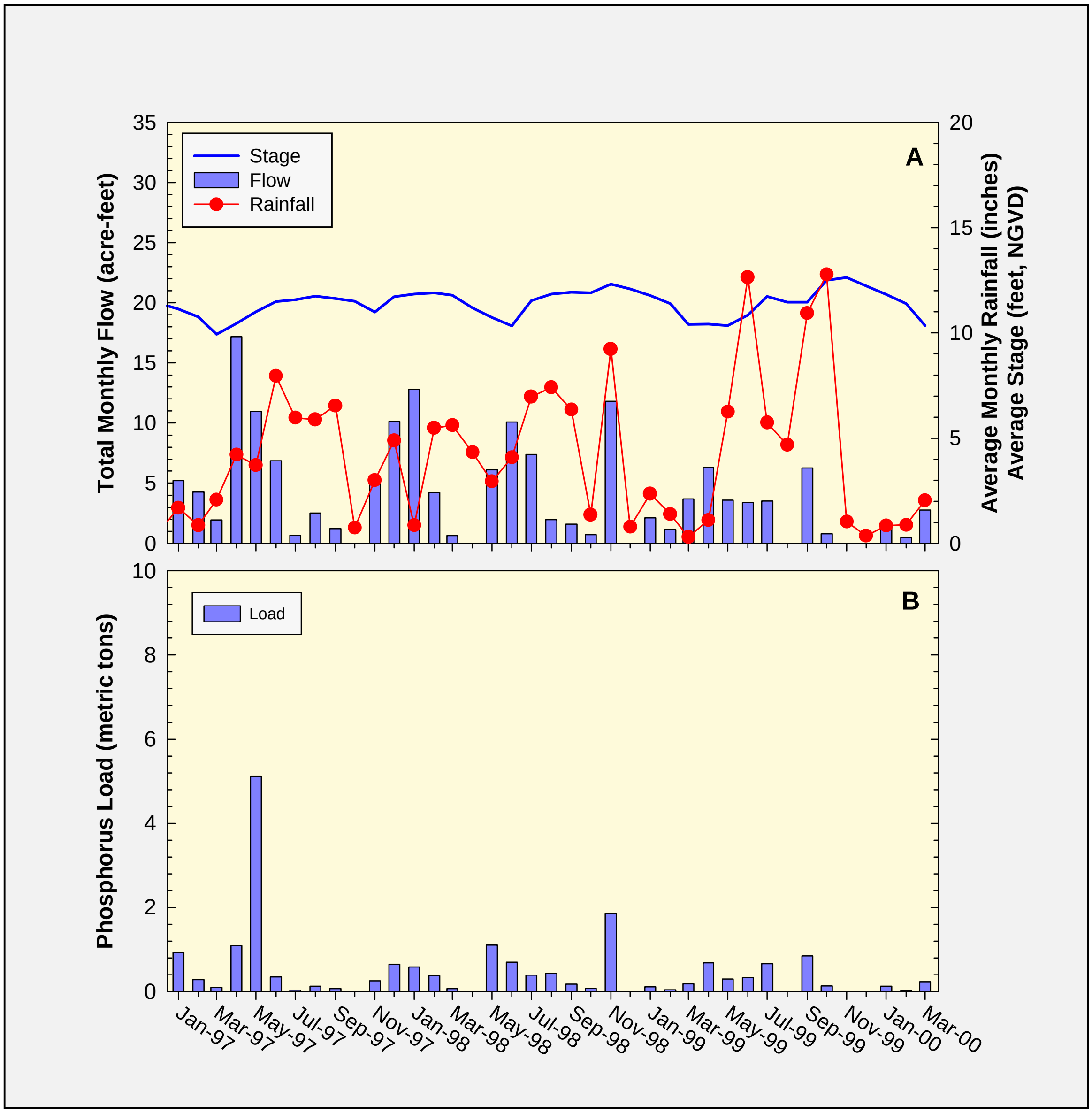

Figure 12. **a.** Flow, rainfall and stage measured at inflow station G200.
b. Phosphorus loads discharged into the Holey Land at inflow station G200.

Phosphorus Loads

Monthly phosphorus loads calculated for inflow site G200 are presented in **Figure 12b**. During the period from January 1997 through March 2000, the monthly load averaged approximately 0.5 metric tons. The highest phosphorus load for this period was observed in May 1997 (**Figure 12**b). The highest flow during this period occurred in April 1997 (**Figure 12**a).

During the first quarter of 2000, 0.4 metric tons of phosphorus entered the Holey Land from G200 (**Figure 12b**). Slightly less phosphorus (0.3 metric tons) was released into the Holey Land during the first quarter of 1999. Although flows to the Holey Land were higher during the first quarter of 1999, the first three months of 2000 exhibited higher loads (**Figure 12b**). Higher phosphorus concentrations in the first quarter of 2000, compared with those for the same period in 1999, contributed to the higher loads.

Phosphorus Concentrations

Figure 13 displays total phosphorus concentrations collected from January 1997 through March 2000 by grab and composite sampling at inflow station G200. Grab samples have been collected at G200 since July 1989, while composite samples have been collected at this site since March 1996.

The total phosphorus concentration for grab samples collected at G200 during the aforementioned reporting period averaged 53 parts per billion (ppb). Composite samples have exhibited an average total phosphorus concentration of 84 ppb during this period. In grab samples collected during the first three months of 2000, total phosphorus concentrations averaged 63 ppb, compared to 77 ppb in composite samples. Overall, total phosphorus concentrations in the first quarter of 2000 (in both the grab and composite samples) were two times higher than for the same period in 1999.

Total phosphorus data collected quarterly at outflow stations G204, G205 and G206 are provided in **Figure 14**. Quarterly grab sample data for these outflow stations are presented from the first quarter in 1997 through the first quarter of 2000.

A total phosphorus concentration gradient is evident at the three outflow stations. Phosphorus concentrations at G204 and G205 are generally higher than at G206 (**Figure 14**). Historically, total phosphorus concentrations at G204 and G205 averaged approximately 57 ppb compared to 13 ppb at G206. The lower total phosphorus concentrations reported for G206 might result from dilution with water from the adjacent seepage canal water that has a phosphorus content lower than in the management area. The canal water is pumped into the Holey Land from seepage return pump stations G200SD and G201. Total phosphorus concentrations measured at G201 and G200SD averaged 12 ppb and 19 ppb, respectively.

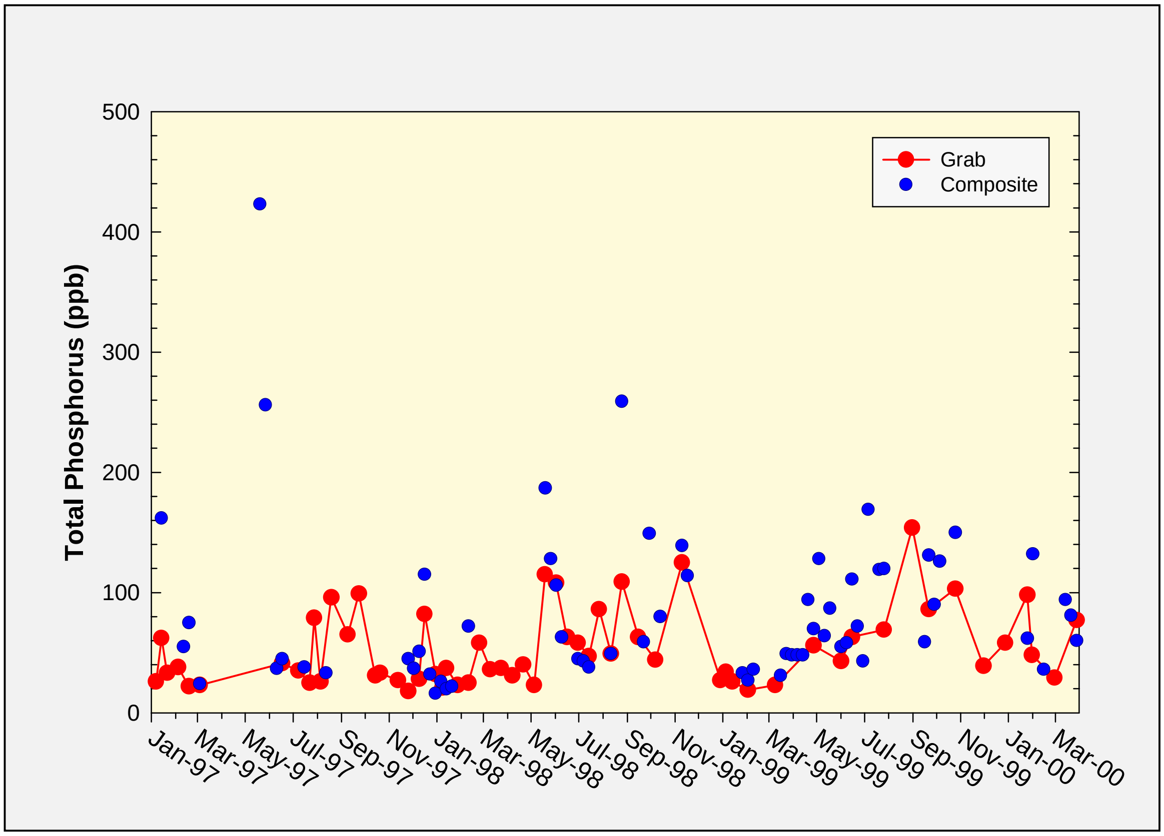

Figure 13. Total phosphorus concentrations for grab and composite samples collected at G200.

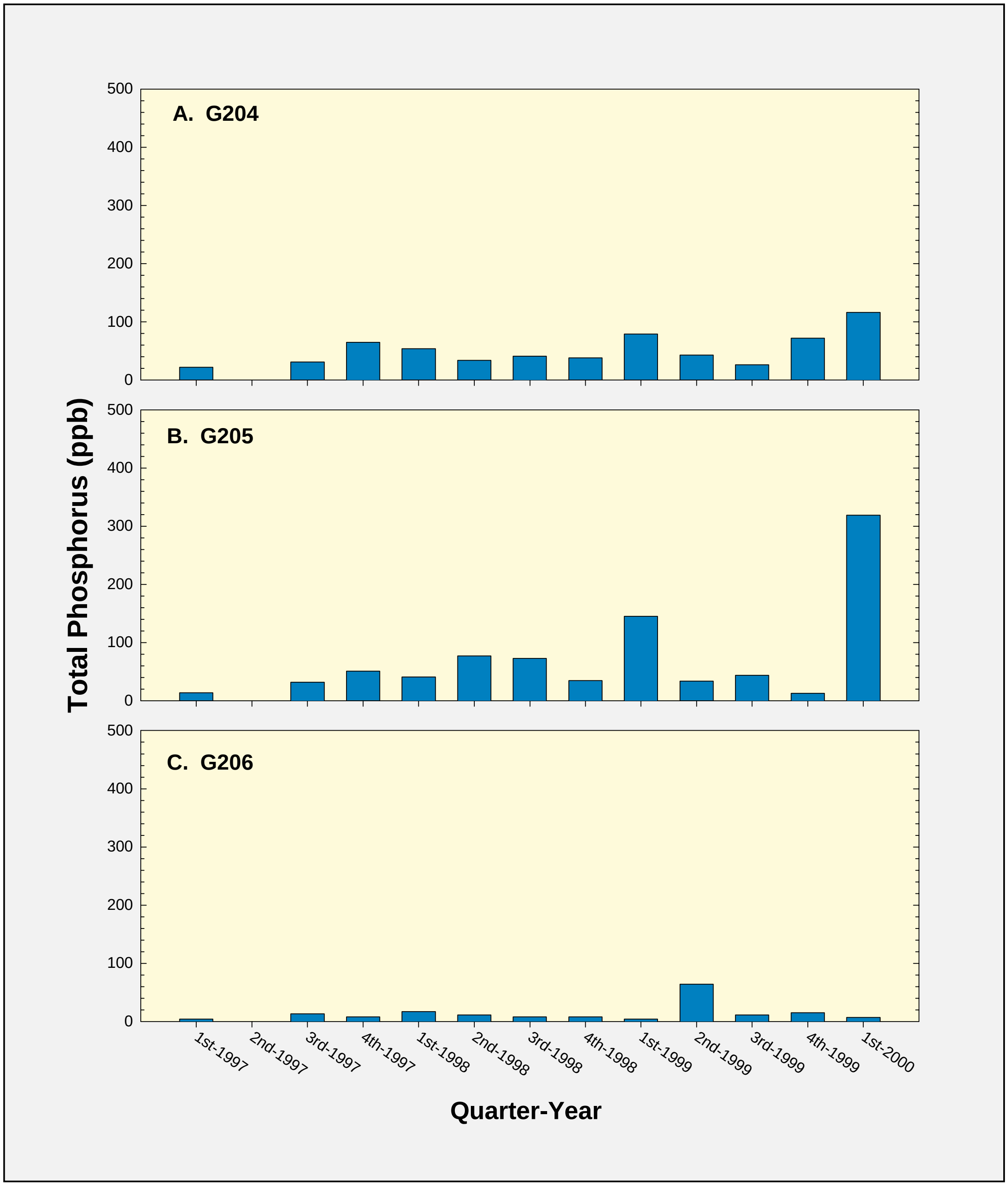

Figure 14. Quarterly total phosphorus concentrations measured for grab samples collected at outflow stations **a.** G204, **b.** G205 and **c.** G206.

STORMWATER TREATMENT AREA 6

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Stormwater Treatment Area 6 (STA-6), Section 1, began full operation Dec. 9, 1997. It occupies an existing detention area associated with United States Sugar Corp.'s (USSC) Southern Division Ranch, Unit 2 development, except for 1 acre that is within the adjacent Rotenberger Tract. STA-6 provides a total effective treatment area of approximately 870 acres. The source of water for STA6 comes solely from USSC's Unit 2 pump station G600.

Phosphorus Concentrations

For the first quarter of 2000, the flow-weighted mean total phosphorus concentrations at the inflow and outflow averaged 64 parts per billion (ppb). Since no discharge occurred at the outflow, no flow-weighted mean could be calculated. The average flow-weighted mean total phosphorus concentration for the period of record at the outflow is 19 ppb, or 3 times lower then the average inflow concentration (**Figure 15a**).

Phosphorus Loads

During January 2000, the calculated total phosphorus load at the inflow was the highest of the three months with 0.075 metric tons (**Figure 15b**). In February, the load was 0.069 metric tons and 0.027 metric tons in March. There were no calculated loads at the outflow because no discharge occurred during the first quarter of 2000 due to the absence of rain (**Figure 15b**). The total phosphorus load reduction for the first quarter of 2000 was 100 percent due to no discharge from STA-6. The overall total phosphorus load has been reduced by 78 percent since the project began in December 1997.

Mercury Concentrations

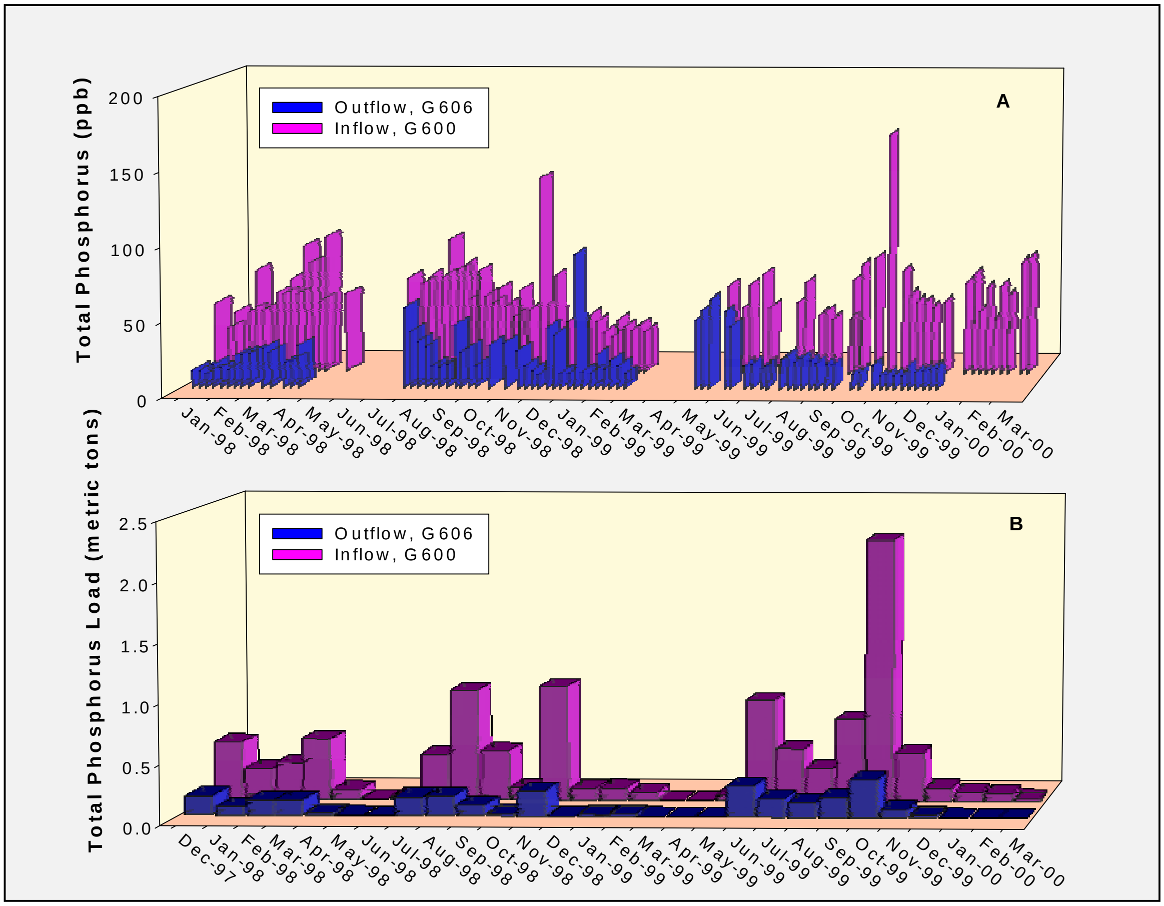

Figure 15. **a.** Weekly flow-weighted mean total phosphorus concentrations at inflow and outflow sites of STA-6, Section 1.
b. Monthly total phosphorus load at inflow and outflow sites of STA-6, Section 1.

The STA-6, Section 1, permit requires the South Florida Water Management District to collect unfiltered water samples from inflow and outflow quarterly for analysis of total mercury (THg) and methylmercury (MeHg). Sampling for mercury started the first quarter of 1998. Samples for the first quarter of 2000 were collected March 13, 2000. At that time, the THg concentrations in the inflow and outflow were 0.77 and 0.42 ng/L, respectively (**Figure 16a**). The MeHg concentrations in the inflow and the outflow were 0.13 and 0.12 ng/L, respectively (**Figure 16b**).

Both the inflow and the outflow sites at STA-6 have THg and MeHg concentrations within the typical range measured previously at the Everglades Nutrient Removal Project. Moreover, THg concentrations in the inflow and outflow were both below the Class III Water Quality Standard of 12 ng/L (**Figure 16a**).

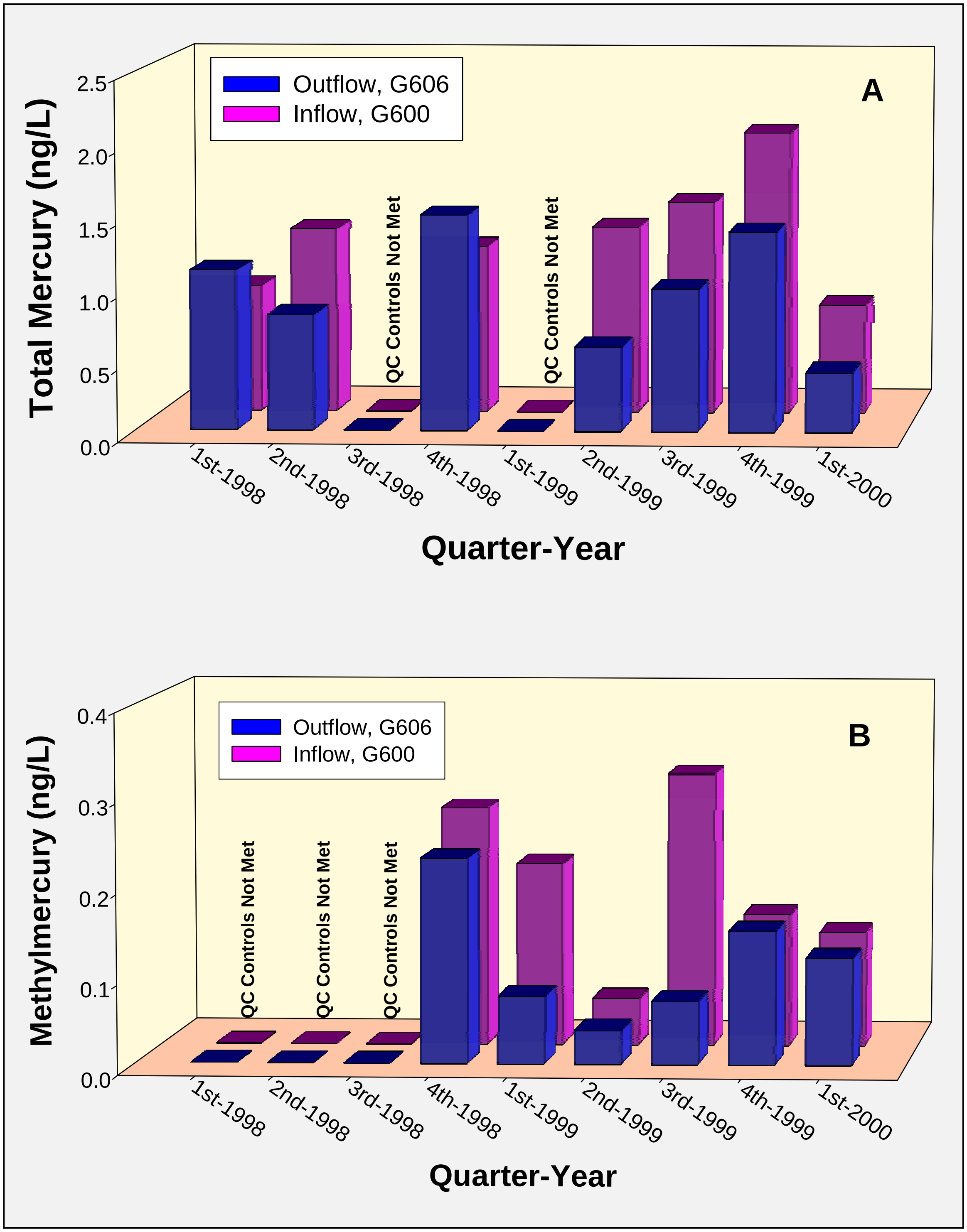

Figure 16. **a.** Quarterly surface water total mercury concentrations at inflow and outflow sites of STA-6. **b.** Quarterly surface water methylmercury concentrations inflow and outflow sites of STA-6.

LOXAHATCHEE NATIONAL WILDLIFE REFUGE

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Phosphorus Concentrations

The Settlement Agreement entered into by the federal government, the Florida Department of Environmental Protection and the South Florida Water Management District in 1991 to end the Everglades lawsuit stipulates interim and long-term phosphorus concentration levels for the Loxahatchee National Wildlife Refuge (Refuge). The interim and long-term concentration levels must be met by Feb. 1, 1999, and Dec. 31, 2006, respectively. The concentration levels vary monthly because they are calculated as a function of water level measured at gaging stations 1-7, 1-8C and 1-9 within the Refuge. Total phosphorus concentrations are determined from water samples collected at the 14 interior marsh stations (LOX 3 through LOX 16) shown on the map above.

The geometric means calculated from total phosphorus concentrations measured in water samples collected in January, February and March 2000 were 8.1, 9.6 and 10.6 ppb, respectively. These geometric mean concentrations were less than the calculated interim and long-term limits for each respective month (**Figure 17**). The interim limits for January, February and March were 10.5, 11.8 and 14.8 ppb, respectively, while the long-term limits for these same months were 8.9, 9.9 and 12.1 ppb, respectively. Average stages in the Refuge were 16.67 feet in January, 16.45 feet in February and 16.06 feet in March.

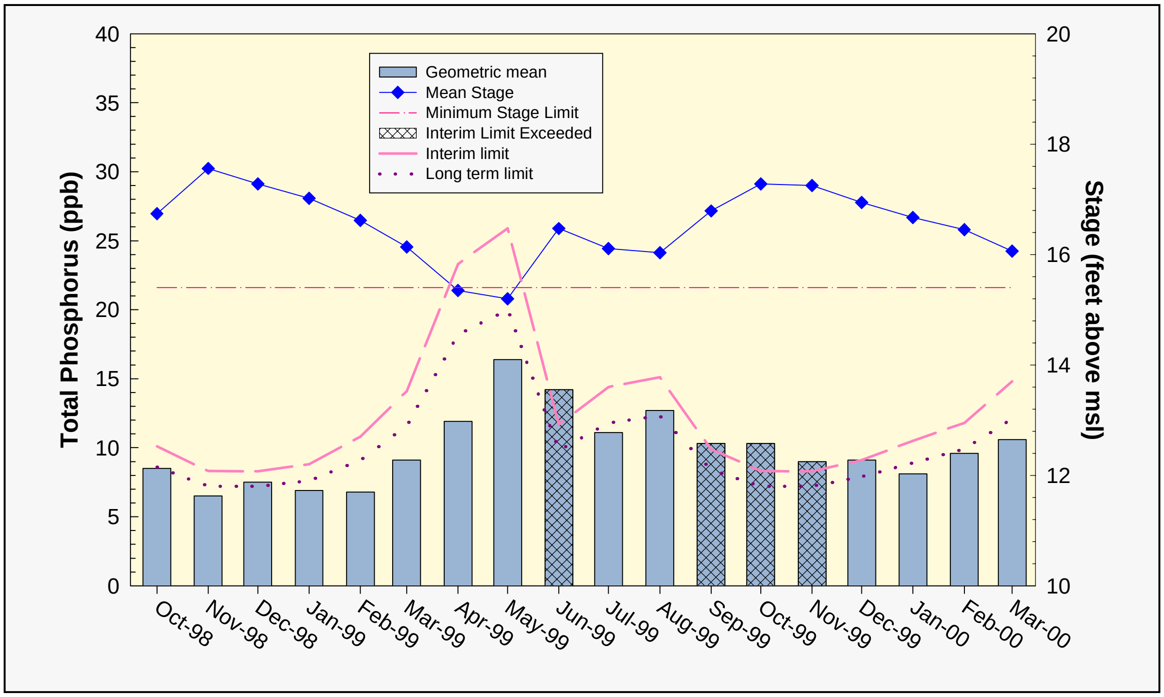

Figure 17. Monthly total phosphorus geometric mean concentration levels for the Loxahatchee National Wildlife Refuge compared to the interim and long-term targets. The calculated target concentrations are adjusted for fluctuations in water level.

EVERGLADES NATIONAL PARK

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Shark River Slough

The Settlement Agreement of 1991 set separate interim and long-term total phosphorus concentration limits for Shark River Slough to be met by Oct. 1, 2003, and Dec. 31, 2006, respectively. The limits apply to the water year ending September 30. The long-term total phosphorus (TP) concentration limit for inflows to Shark River Slough through structures S12A, S12B, S12C, S12D and S333 represents the concentrations delivered during the Outstanding Florida Waters baseline period of March 1, 1978, to March 1, 1979, and is adjusted for variations in flow. In addition, the Settlement Agreement requires that phosphorus concentrations be presented as 12-month moving flow-weighted means.

Inflow concentrations of total phosphorus to the Everglades National Park through Shark River Slough are compared to the interim and long-term limits at the end of each water year (**Figure 18a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 1999 was 9.5 parts per billion (ppb). The interim and long-term limits for September 1999 were 9.8 and 8.2 ppb, respectively. **Figure 18b** presents the monthly 12-month moving flow-weighted mean concentrations from the beginning of water year 1999, Oct. 1, 1998, and composite total phosphorus concentrations for each sampling event. Some of the water discharged from S333 is not delivered to Shark River Slough but goes to S334. Flow through S334 is subtracted from S333 flow for the limits and concentration calculations starting from this water year (Oct. 1, 1999, through Sept. 30, 2000).

The 12-month flow-weighted mean concentrations for January, February and March 2000 were 9.4, 9.3 and 9.5 ppb, respectively. The January and February values were the same as or below the interim discharge limits of 9.4 and 9.3, respectively, but the March value of 9.5 was greater than the 9.4 ppb interim limit. All three months were above the long-term discharge limit of 7.6 ppb.

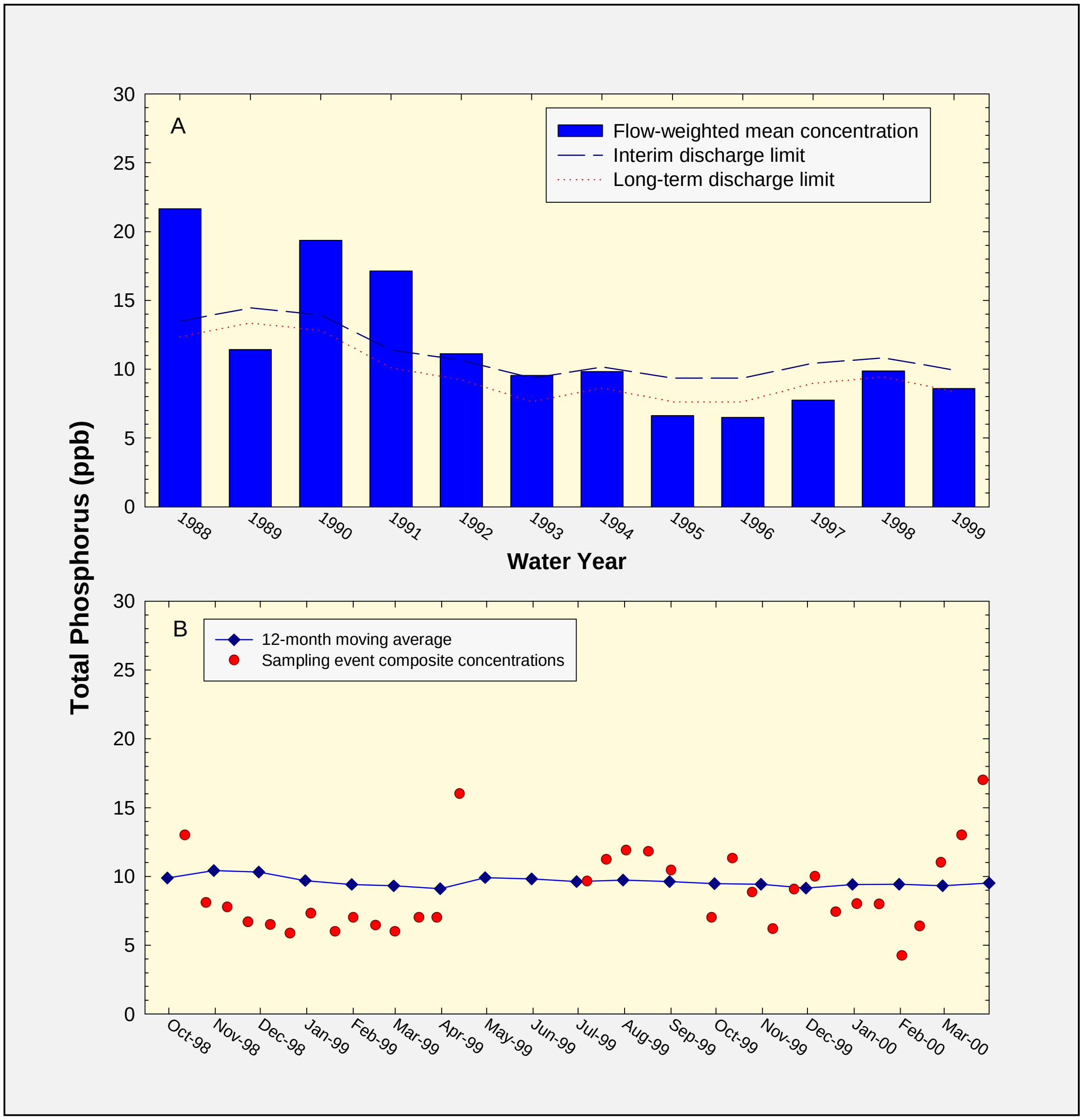

Figure 18. 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to Everglades National Park (ENP) through Shark River Slough compared to the interim and long term targets. **a.** Concentration at the end of each water year. **b.** 12-month moving average concentration at the end of each month and the composite concentration for each sampling event.

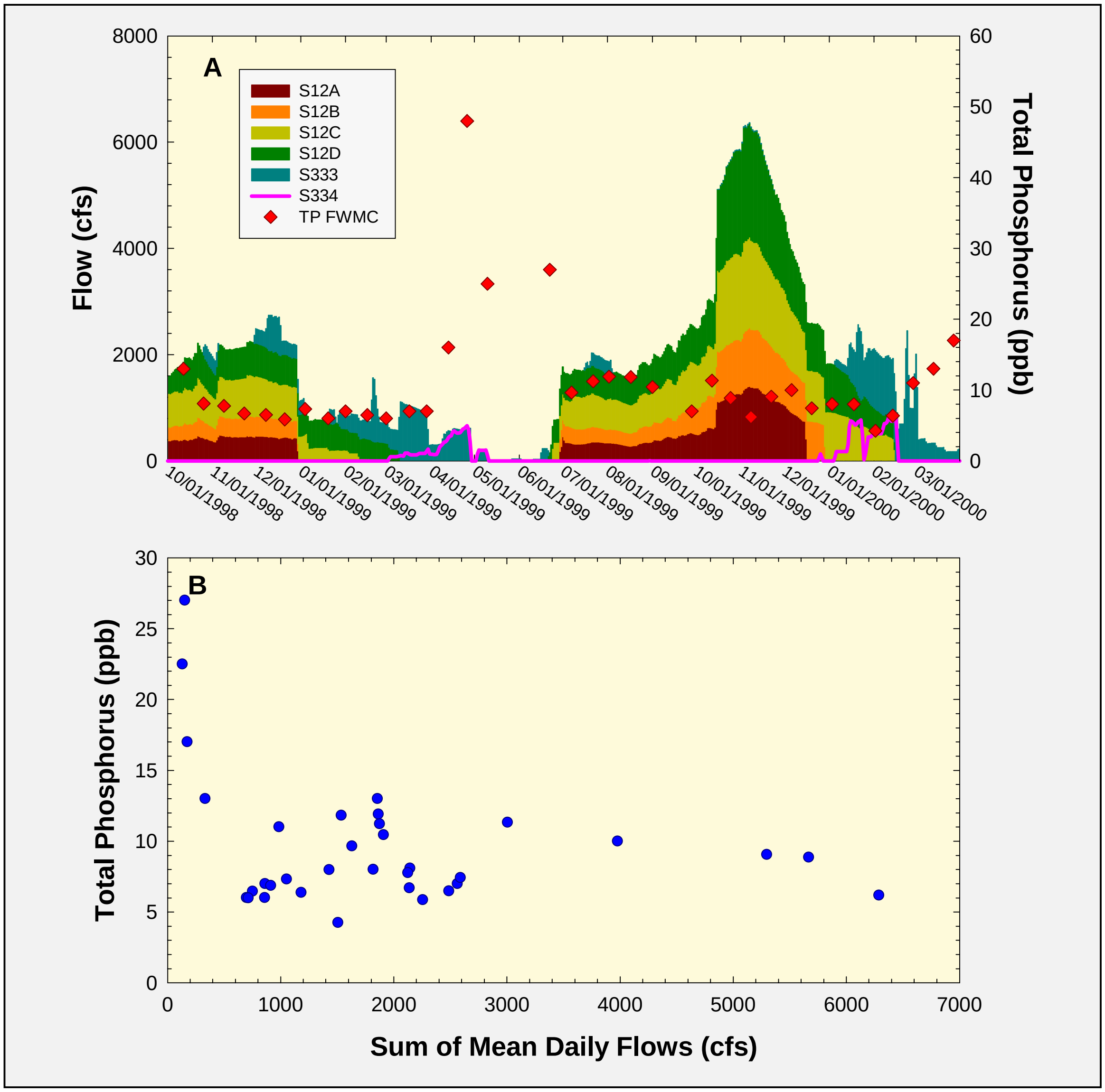

Figure 19. **a.** Daily mean flows into the Everglades National Park through the Shark River Slough structures and the flow-weighted mean total phosphorus concentration collected at each sampling event. **b.** The relationship between the total flow at Shark River Slough structures and the flow-weighted mean total phosphorus concentration.

The 12-month flow-weighted mean concentrations for **Figure 19a** presents daily mean flows for Shark River Slough structures and S334, and flow-weighted mean total phosphorus concentration for each sampling event. **Figure 19b** shows that flow-weighted-mean TP concentrations at Shark River Slough are inversely related to the total flow of the structures.

The Settlement Agreement also stipulates that the percent of composite samples having concentrations greater than 10 ppb total phosphorus in any water year must not exceed a calculated value based on annual flow into Shark River Slough through the inflow structures. For the 12-month periods ending January, February and March 2000, the percent of composite samples with total phosphorus concentrations greater than 10 ppb was 47.8, 50.0 and 60.9 for January, February and March, respectively. These percentages would have exceeded the allowable limit of 40.1 percent for all three months, if this stipulation was in effect.

Taylor Slough and The Coastal Basins

Under the Settlement Agreement, a single limit for total phosphorus of 11 ppb, to be met by Dec. 31, 2006, was set for the two points of inflow to Taylor Slough (S332 and S175) and the inflow point to the Coastal Basins (S18C). The limit applies to the water year ending Sept. 30. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, began operation. The structure is adjacent to spillway S174 and pumps water from the L31N canal into the L31W canal. The S332D and S174 structures became the new inflow compliance monitoring sites on Oct.1, 1999, replacing S332 and S175.

Inflow concentrations of total phosphorus to the Everglades National Park through Taylor Slough and the Coastal Basins are compared to the fixed long-term limit of 11 ppb at the end of each water year using data from both the old and new combinations of compliance monitoring sites for the 1999 water year (**Figure 20a**). The bars in **Figure 20a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1988 through 1999. The diamond point value for water year 1999 represents the flow-weighted mean total phosphorus concentration for S174 and S18C from Oct. 1, 1998 through Sept. 30, 1999, plus the S332D data from Aug. 30, 1999, through September 30, 1999.

Figure 20b presents the monthly 12-month moving flow-weighted mean concentrations beginning with the 1999 water year, Oct. 1, 1998, and the composite total phosphorus concentrations for each sampling event using both the old and new combinations of compliance monitoring sites. The 12-

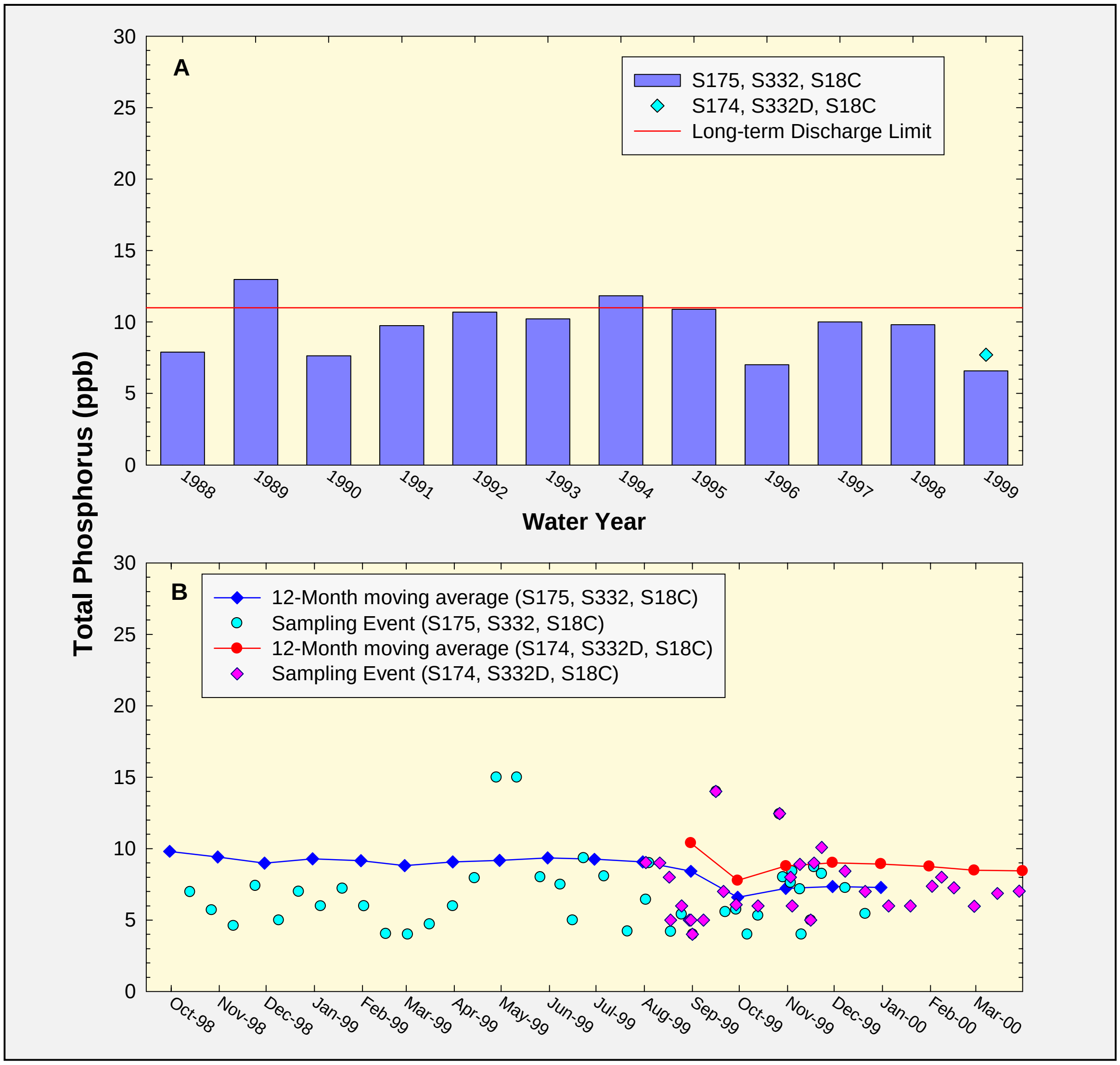

Figure 20. **a.** Flow-weighted mean total phosphorus concentration at the inflows to Everglades National Park through Taylor Slough and the Coastal Basins compared to the long-term limit for each water year. **b.** 12-month moving average total phosphorus concentration at the end of each month and the flow-weighted mean total phosphorus concentration for each sampling event.

month flow-weighted mean concentrations for January, February and March 2000 were 8.0, 7.9 and 7.9 ppb, respectively, for the old S332, S175 and S18C combination. The concentrations for the new combination of S332D, S174 and S18C for January, February and March were 9.5, 9.1 and 9.1, respectively.

The Settlement Agreement stipulates that the percent of composite samples greater than 10 ppb total phosphorus in any water year must not exceed a fixed value of 53.1 percent. The percent of composite samples with concentrations greater than 10 ppb for the old combination of structures was 15.4, 15.0 and 15.4 for the 12-month periods ending January, February and March 2000, respectively. For the new combination of structures, the percentages were 15.0, 14.3 and 14.6 for January, February and March, respectively.

A comparison of flows between the old and new combination of structures is presented in **Figure 21**.

The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, are presented in **Figure 21a**. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D. However, the total flows at the downstream structures are very often greater than those at the upstream structures. Because there are no additional inflow structures in the L31W canal, this additional water is probably the result of water seeping into the canal. **Figure 21b** shows the relationship between daily flow and TP concentration for each sampling event. There has been no relationship between flow and TP concentrations at the old combination of structures; that is, TP concentration is independent of flow. The same independent relationship is observed at the new combination of structures.

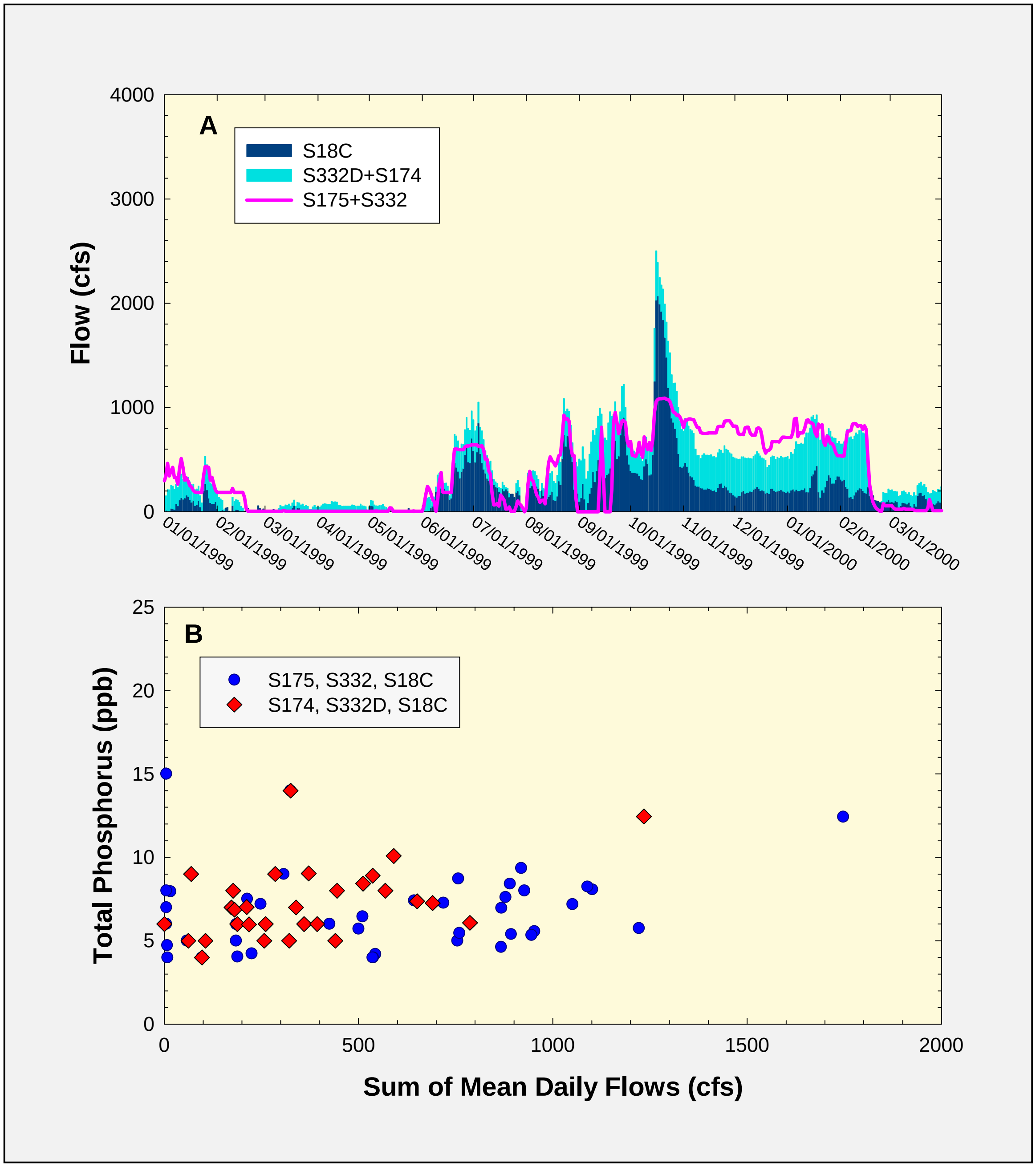

Figure 21. **a.** Daily mean flows into Everglades National Park through Taylor Slough and Coastal Basins structures**. b.** The relationship between the total flow through Taylor Slough and Coastal Basins structures and the flow-weighted mean total phosphorus concentrations at

FLORIDA BAY

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As part of the Everglades Forever Act, the South Florida Water Management District, in collaboration with the Everglades National Park and Florida International University, is required to monitor water quality in Florida Bay. Salinity and chlorophyll *a* are used as indicators of water quality within Florida Bay.

Salinity

As an estuary, Florida Bay requires a properly maintained salinity regime for the overall ecological health of the bay. Salinity can be defined as the grams of salt dissolved in a kilogram of water and is expressed in units of parts per thousand (ppt). Within the bay, salinity is affected by freshwater input, in the form of rainfall and surface water runoff from the Everglades, and transport of seawater into the bay predominantly from the Gulf of Mexico. Because the bay is a shallow and wide lagoon, evaporation also affects salinity levels. When evaporation exceeds freshwater input, portions of the bay can become hypersaline. Water conditions in the bay are considered hypersaline when salinity exceeds 35 ppt, which is the approximate mean salinity of ocean water. The central portion of the bay contains small basins surrounded by shallow seagrass banks that extend toward the western edge of Florida Bay. Because of the bathymetry of this region, it is especially susceptible to hypersaline conditions.

Maps showing salinity contours within Florida Bay from January through March 2000 are depicted in **Figures 22a** through **22c**. Overall, salinity in Florida Bay during the first quarter of 2000 ranged from 3.8 to 36.5 ppt.

One station during February and March 2000 exhibited a salinity greater than 35 ppt (**Figures 22b** and **22c**). Bay-wide salinities measured during the first quarter of 2000 averaged 24.7, 25.7 and 27.9 ppt for January, February and March, respectively. The lowest salinities were measured in January. More saline waters from the Gulf of Mexico extended further into the bay throughout the first quarter as freshwater input from runoff and rainfall decreased.

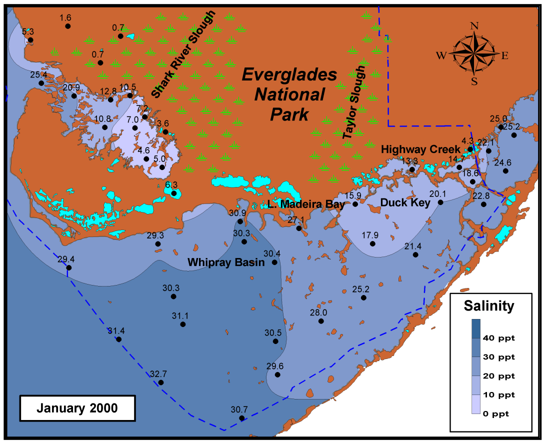

Figure 22a. Salinity in Florida Bay and the western coast of the Everglades National Park for January 2000 (Data collected by Florida International University.)

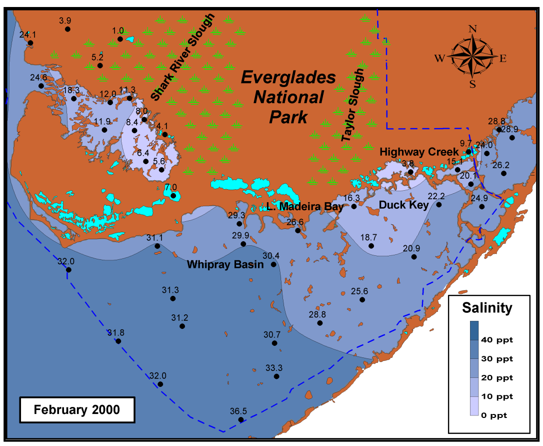

Figure 22b. Salinity in Florida Bay and the western coast of the Everglades National Park for February 2000 (Data collected by Florida International University.)

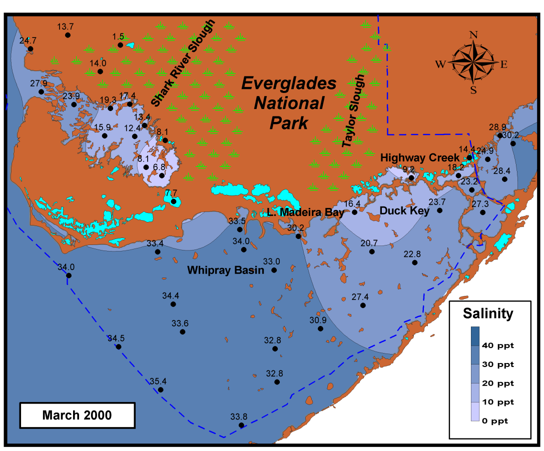

Figure 22c. Salinity in Florida Bay and the western coast of the Everglades National Park for March 2000 (Data collected by Florida International University.)

Salinity levels measured over the last three years at monitoring sites in Highway Creek, Duck Key, Little Madeira Bay and Whipray Basin are presented as **Figure 23**. A summary of salinities recorded at these monitoring sites for the first quarter of 2000 is also presented in **Table 5**. In general, salinities measured during this period increased at the four monitoring sites (**Figure 23**). Highway Creek exhibited a 10 ppt increase in salinity from January to March (**Table 5**). Due to its proximity to a freshwater source, wide salinity swings are common for this site (**Figure 23**). The other three monitoring sites exhibited smaller variations in salinity during this period (**Table 5**).

Table 5. Salinity in Florida Bay (ppt)

	Jan-00	Feb-00	Mar-00
Highway Creek	4.4	9.7	14.4
Duck Key	20.1	22.2	23.7
L. Madeira Bay	15.9	16.3	16.4
Whipray Basin	30.4	30.4	33.0

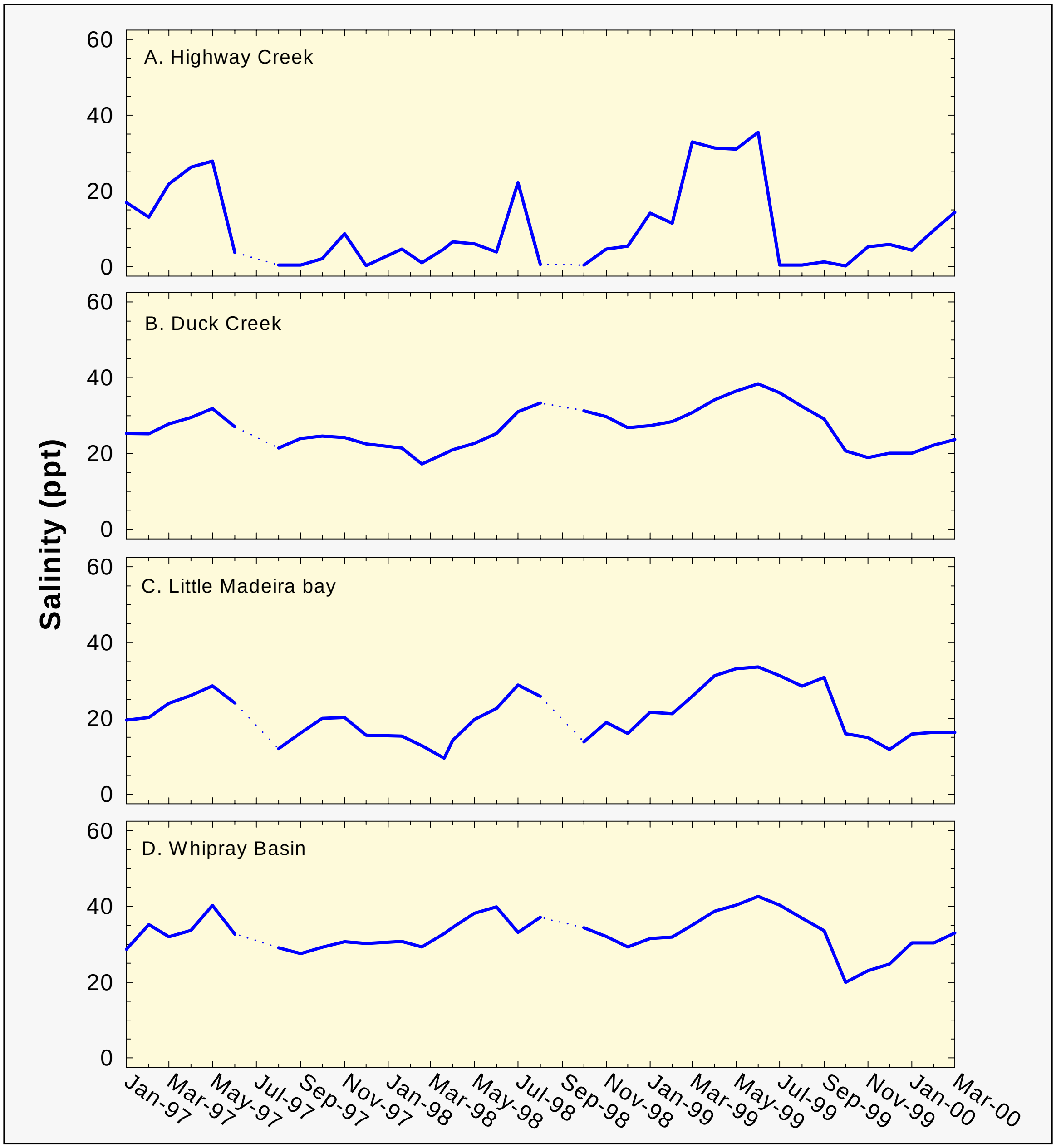

Figure 23. Salinity at four sites in Florida Bay from January 1, 1997, through March 30, 2000 (dotted lines indicate missing data).

Chlorophyll *a* Concentrations

Large areas of dense algal communities can affect the overall health of the Florida Bay ecosystem. Chlorophyll *a* concentrations measured in the bay are an indicator of algae (phytoplankton) biomass. Regional chlorophyll *a* concentrations in Florida Bay and the west coast of the Everglades National Park are collected monthly. The distributions of chlorophyll *a* levels measured in the bay during the first three months of 2000 are shown in **Figures 24a** through **24c.**

During the first quarter of 2000, chlorophyll *a* concentrations in Florida Bay averaged 2.4 parts per billion (ppb) and ranged from 0.4 to 17.5 ppb. From January through March 2000, mean chlorophyll *a* concentrations in the bay were variable. The eastern and southern portions of Florida Bay had lower chlorophyll *a* levels, as observed in previous report. The highest chlorophyll *a* levels in Florida Bay were consistently observed at Garfield Bight and Rankin Basin (both areas are located directly northwest of Whipray Basin)(**Figures 24a** and **24c**). These elevated chlorophyll *a* levels may be attributed to nutrient inputs to the bay from runoff as well as turbulent mixing from the passage of cold fronts resulting in the resuspension of sediments.

Chlorophyll *a* concentrations measured at four sampling stations in Florida Bay over the past three years of monitoring are shown in **Figure 25**. In addition, chlorophyll *a* concentrations measured during the first quarter of 2000 are summarized in **Table 6**. In general, chlorophyll *a* levels at these monitoring sites were higher during the first three months of 2000 than during the same period in 1999.

Two sites (Highway Creek and Duck Key) exhibited an increase in monthly chlorophyll *a* levels during the first quarter of 2000. At both sites, chlorophyll *a* levels increased by approximately 1 ppb. Conversely, chlorophyll *a* levels at Whipray Basin decreased by almost 3 ppb during this period

Table 6. Chlorophyll a in Florida Bay (ppb)

	Jan-00	Feb-00	Mar-00
Highway Creek	0.6	1.0	2.0
Duck Key	0.4	0.9	1.1
L. Madeira Bay	1.0	0.8	1.0
Whipray Basin	7.9	6.2	5.2

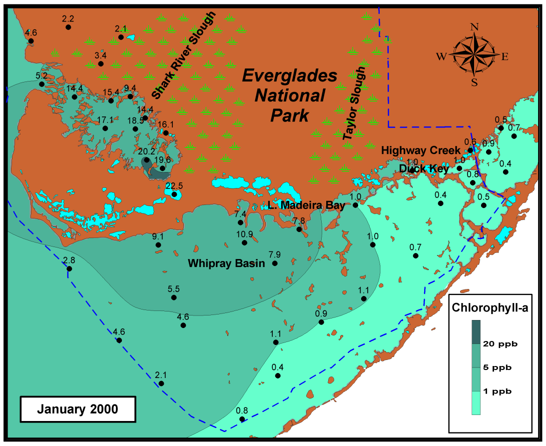

Figure 24a. Concentrations of chlorophyll *a* in Florida Bay and the western coast of Everglades National Park for January 2000. (Data collected by Florida International University.)

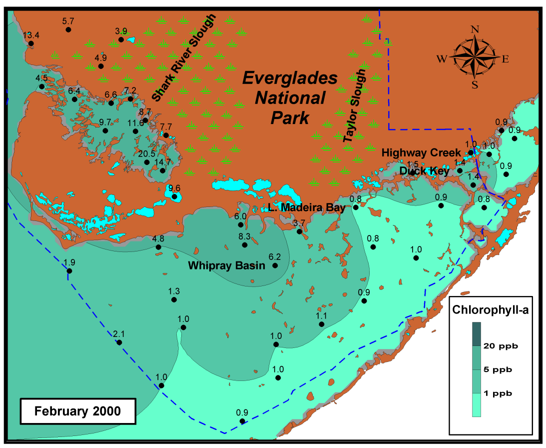

Figure 24b. Concentrations of chlorophyll *a* in Florida Bay and the western coast of Everglades National Park for February 2000. (Data collected by Florida International University.)

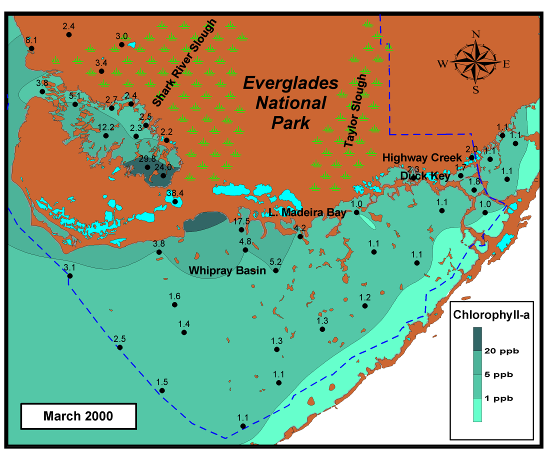

Figure 24c. Concentrations of chlorophyll *a* in Florida Bay and the western coast of Everglades National Park for March 2000. (Data collected by Florida International University.)

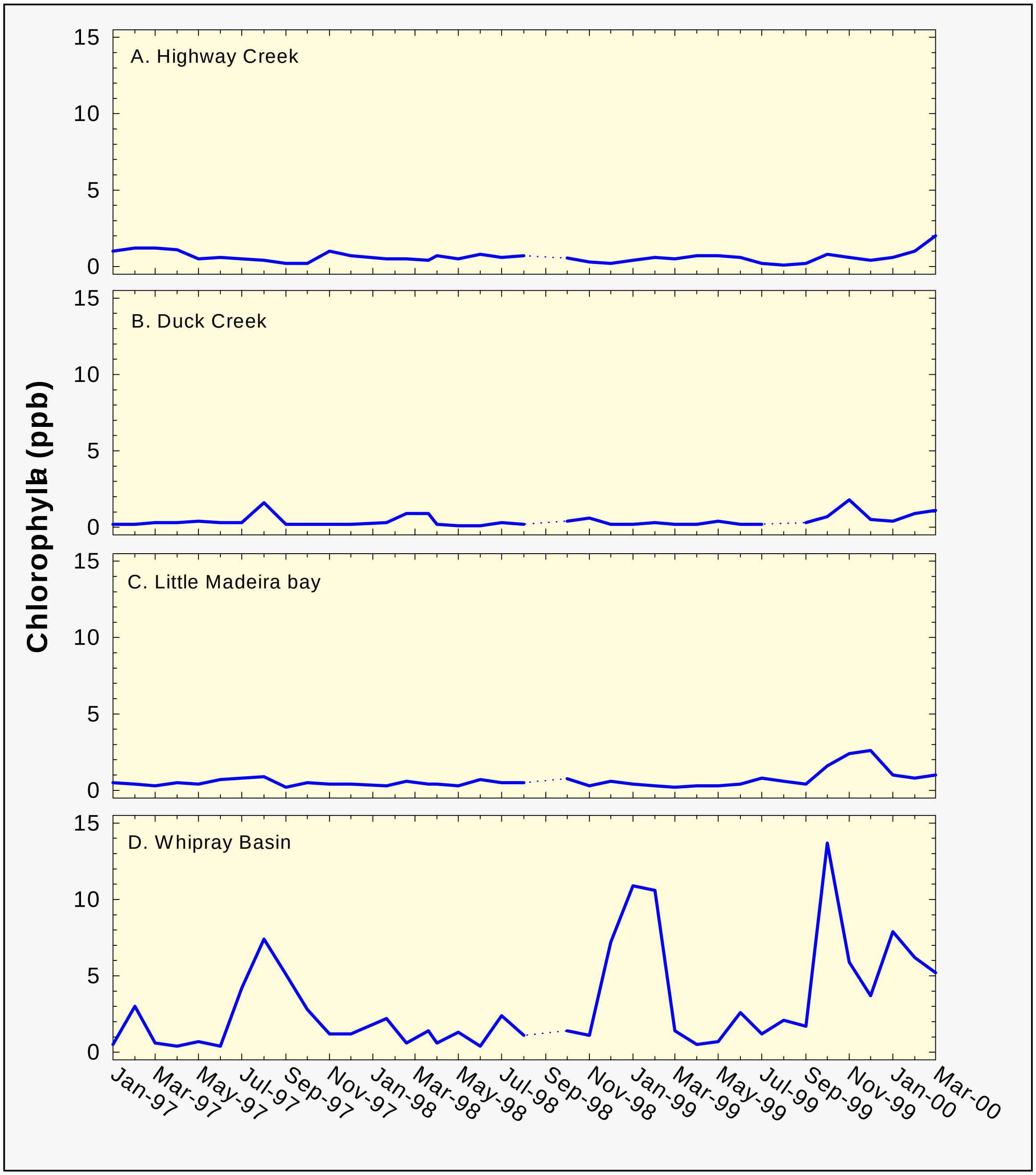

Figure 25. Chlorophyll *a* concentrations at four sites in Florida Bay from Jan. 1, 1997, through March 31, 2000 (dotted lines indicate missing data).

PESTICIDE MONITORING PROGRAM

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As part of the South Florida Water Management District's quarterly ambient monitoring program, unfiltered water samples from 36 sites were collected from Feb. 7 - 10, 2000, and analyzed for over 60 pesticides and/or products of their degradation. Sediment was not collected for this sampling event. The herbicides ametryn, atrazine, bromacil, hexazinone, metolachlor, norflurazon, prometryn, and simazine, along with the insecticides/degradates atrazine desethyl, atrazine desisopropyl, alpha endosulfan, beta endosulfan, and endosulfan sulfate were detected in one or more of these surface water samples. The compounds and concentrations found are typical of those expected from intensive agricultural activity.

The District's pesticide monitoring network includes stations designated in the Everglades National Park Memorandum of Agreement, the Miccosukee Tribe Memorandum of Agreement, the Lake Okeechobee Operating Permit, and the Non-Everglades Construction Project (Non-ECP) permit. Surface waters are sampled quarterly and sediments semiannually.

Surface Water

At least one pesticide was detected in surface water at 34 of the 36 sites. The concentrations of the pesticides detected at each of the sites are summarized for the surface water in **Table 7**. All these compounds have previously been detected in this monitoring program.

No ethion was detected in the surface water at any of the sampling sites. Since October 1995, 8 out of 18 sampling events at S99 had a detectable level of ethion in the surface water. With the method detection limit around 0.02 µg/L, any detection will automatically exceed the calculated chronic toxicity (0.003 µg/L) for *Daphnia magna*.

The endosulfan (α plus β) surface water concentration detected at S178 (0.058 µg/L) during this sampling event exceeds the Florida Class III surface water quality standard (Chapter 62-302) of 0.056 µg/L. This is the first time an exceedance of the water quality standard has occurred at S178 since January 1996.

The above findings must be considered with the caveat that pesticide concentrations in surface water may vary significantly with relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible long-term or chronic toxicity impacts are also reported based on the single sampling event and do not take into account previous monitoring data.

To view the comlete February 2000 Pesticide Surface Water Quality Report, visit: http://www.sfwmd.gov/curre/pest/pestindex.htm.

Table 7. Concentrations of Pesticide in Surface Water Samples

DATE	SITE	FLOW	COMPOUNDS (µg/L) ametryn	atrazine	atrazine desethyl	atrazine desisopropyl	bromacil	alpha endosulfan	beta endosulfan	endosulfan sulfate	hexazinone	metolachlor	norflurazon	prometryn	simazine
2/7/00	S38B	N	0.011 I	0.65	0.045 I	-	-	-	-	-	-	-	-	-	-
	G123	N	0.014 I	0.11	-	-	-	-	-	-	-	-	-	-	-
	S142	Y	0.025 I	0.16	-	-	-	-	-	-	-	-	-	-	-
	S9	N	0.013 I	0.011 I	-	-	-	-	-	-	-	-	-	-	-
	S31	Y	0.013 I	0.090	-	-	-	-	-	-	-	-	-	-	-
	S12C	Y	-	0.025 I*	-	-	-	-	-	-	-	-	-	-	-
	US41-25	Y	-	0.033 I	-	-	-	-	-	-	-	-	-	-	-
	G211	Y	-	0.025 I	-	-	-	-	-	-	-	-	-	-	-
	S331	Y	-	0.021 I	-	-	-	-	-	-	-	-	-	-	-
	S176	Y	-	0.022 I	-	-	-	-	-	-	-	-	-	-	-
	S332	Y	-	0.020 I	-	-	-	-	-	-	-	-	-	-	-
	S177	Y	-	0.014 I	-	-	-	0.031	0.0084 I	0.0033 I	-	-	-	-	-
	S178	N	-	0.043 I	0.015 I	-	-	0.04	0.018	0.15	-	-	-	-	-
	S18C	Y	-	0.017 I*	-	-	-	-	0.0047 I*	0.0079 I*	-	-	-	-	-
2/8/00	S140	N	-	0.025 I	-	-	-	-	-	-	0.026 I	-	-	-	-
	S190	N	-	0.044 I	-	-	-	-	-	-	-	-	0.036 I	-	-
	L3BRS	N	-	-	0.0099 I	-	-	-	-	-	-	-	-	-	-
	S8	N	-	-	-	-	-	-	-	-	-	-	-	-	-
2/9/00	G94D	Y	0.046 I	1.1	0.041 I	-	0.043 I	-	-	-	-	0.10 I	-	-	-
	ACME1DS	Y	0.041 I	1.1	0.043 I	-	-	-	-	-	-	0.11 I	-	-	-
	S80	N	-	0.11	0.020 I	-	0.061 I	-	-	-	-	-	0.24	-	-
	GORDYRD	Y	-	-	-	0.033 I	0.19 I	-	-	-	-	-	0.66	-	1.3
	C255S99	N	-	-	-	0.010 I	0.052 I	-	-	-	-	-	0.8	-	-
	S191	N	-	-	-	-	0.050 I	-	-	-	-	-	-	-	-
	S65E	Y	-	0.067	0.011 I	-	-	-	-	-	-	-	-	-	-
	FECSR78	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
2/10/00	S78	Y	0.015 I	0.16	0.018 I	-	-	-	-	-	-	-	0.037 I	-	-
	CR33.5T	N	-	0.08	0.015 I	-	0.16 I	-	-	-	-	-	0.17	-	0.14
	S79	Y	-	0.089 *	0.013 I*	-	-	-	-	-	-	-	0.086 I*	-	0.029 I*
	S235	R	0.039 I*	0.32 *	0.032 I*	-	-	-	-	-	-	-	-	-	-
	S4	N	-	0.14	0.024 I	-	-	-	-	-	-	-	-	-	-
	S3	N	-	0.14	0.025 I	-	-	-	-	-	-	-	-	-	-
	S2	N	0.017 I	0.30	0.028 I	-	-	-	-	-	-	-	-	-	-
	S7	Y	0.063	1.5	0.029 I	-	-	-	-	-	-	-	-	-	-
	S6	Y	0.10	0.89	0.030 I	-	-	-	-	-	-	0.38	-	0.13	-
	S5A	Y	0.062	1.3	-	-	-	-	-	-	-	-	-	-	-
Total number of compound detections			13	30	16	2	6	2	3	3	1	3	7	1	3

N = no Y = yes R = reverse; - denotes that the result is below MDL; * - results are average of duplicate samples; I = value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.

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GLOSSARY

12-month moving average
The mean (arithmetic average) of data from 12 consecutive months. As the latest month is added to the data set, the earliest month is dropped from the data set

5-year moving average
The mean (arithmetic average) of data from 5 consecutive annual averages of sums. When the latest year is added to the data set the earliest year is dropped from the data set.

flow-weighted mean

The arithmetic average adjusted for flow:

$$\bar{x} = \frac{\left(\sum_{i=1}^{i=n} q_i c_i\right)}{\left(\sum_{i=1}^{i=n} q_i\right)}$$

q = flow
c = concentration

geometric mean

The nth root of individual data values that have been multiplied:

$$G = \sqrt[n]{x_1 x_2 \ldots . x_n}$$

EC_{50}
A concentration necessary for 50 percent of the aquatic species tested to exhibit a toxic effect short of mortality within a short exposure period, usually 24 to 96 hours.

units of concentration measurement
(assuming density of water = 1.0)

grams/kilograms	(g/kg) =	1 part /thousand (ppt)
milligram/Liter	(mg/L) =	1 part/million (ppm)
microgram/Liter	(µg/L) =	1 part/billion (ppb)
nanogram/Liter	(ng/L)	

FOR MORE INFORMATION

C O N T A C T

Thomas D. Fontaine, Ph.D.
Director
Environmental Monitoring & Assessment Division
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33416-4680

(561) 682-6551
fontaine@sfwmd.gov